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TRANSACTIONS

AMERICAN FISHERIES SOCIETY

NINETEEN HUNDRED TWO

TRANSACTIONS

OF THE

AMERICAN FISHERIES SOCIETY

AT ITS

Thirty-first Annual Meeting

AUGUST 5, 6 AND 7, 1902.

Headquarters of the Meeting, Hotel Victory, Put-in-Bay, Ohio.

APPLETON, WIS.
THE POST PUBLISHING COMPANY, PRINTERS AND BINDERS.
1902.

Officers for 1902-1903.

President, - - - - GEORGE M. BOWERS, Washington, D. C.
Vice-President, - - HENRY B. WARD, Lincoln, Neb.
Recording Secretary, - GEORGE F. PEABODY, Appleton, Wis.
Corresponding Secretary, - JOHN E. GUNCKEL, Toledo, O.
Treasurer, - - - C. W. WILLARD, Westerly, R. I.

EXECUTIVE COMMITTEE.

GEORGE T. MATHEWSON, *Chairman*, Thompsonville, Conn.

W. H. BOARDMAN, Central Falls, R. I.
E. A. BIRGE, Madison, Wis.
J. J. STRANAHAN. Bullochville, Ga.
DWIGHT LYDELL, Mill Creek, Mich.
TARLETON H. BEAN, at World's Fair, St. Louis, Mo.

PART I.

BUSINESS SESSIONS.

Transactions of the American Fisheries Society.

Tuesday, August 5, 1902.

Convention called to order at 2:30 p. m., by the Recording Secretary, Mr. George F. Peabody, and on motion duly made and seconded, Mr. F. B. Dickerson, of Detroit, was elected temporary chairman, in the absence of President Bryant.

The registered attendance at the meetings of the Society is as follows:

Bean, Hon. Tarleton H., at World's Fair, St. Louis, Mo.
Birge, E. A., Madison, Wis.
Boardman, William H., Central Falls, R. I.
Booth, Dewitt C., Spearfish, S. D.
Bowers, George M., United States Fish Commissioner.
Brewster, C. E., Grand Rapids, Mich.
Brown, G. W. M., Saginaw, Mich.
Bryant, E. E., President, Madison, Wis.
Clark, F. N., Detroit, Mich.
Cole, Leon J., Ann Arbor, Mich.
Coulter, A. L., Michigan.
Dean, H. D., Neosho, Mo.
Dickerson, F. B., Detroit, Mich.
Downing, S. W., Put-in-Bay, Ohio.
Filkins, B. G., Northville, Mich.
Fox, J. C., Put-in-Bay, O.
Geer, E. Hart, Hadlyme, Conn.
Green, Dr. Duff W., Dayton, O.
Gunckel, J. E., Toledo, Ohio.
Hogan, J. J., Wisconsin.
Lane, George F., Silver Lake, Mass.
Lydell, Dwight, Mill Creek, Mich.
Marsh, M. C., Washington, D. C.
Mathewson, G. T., Enfield, Conn.

Morris, E. H., Washington, D. C.
Morton, William P., Providence, R. I.
Palmer, W. A., Buchanan, Mich.
Peabody, George F., Appleton, Wis.
Pike, R. G., Middleton, Conn.
Plumb, C. H., Mill Creek, Mich.
Reighard, Jacob, Ann Arbor, Mich.
Roberts, A. D., Woonsocket, R. I.
Root, Henry T., Providence, R. I.
Seagle, George A., Wytheville, Va.
Stranahan, F. A., Cleveland, Ohio.
Stranahan, J. J., Georgia.
Titcomb, J. W., Vermont.
Ward, Henry B., Lincoln, Neb.
Willard, C. W., Westerly, R. I.
Wires, S. T., Duluth, Minn.
White, R. Tyson, Brooklyn, N. Y.
Wollett, W. H., Put-in-Bay, O.

During the several sessions the following gentlemen were elected to membership in the Society:

Allen, A. D., Flora, Ore.
Ashford, W. T., Atlanta, Ga.
Bean, Tarleton H., St. Louis, Mo.
Benton, Judge Henry T., Scale, Ala.
Booth, DeWitt C., Spearfish, South Dak.
Boudre, N. H., Plummerville, Ark.
Brown, George H., Jr., Washington, D. C.
Burham, E. K., Northville, Mich.
Carter, E. N., St. Johnsbury, Vt.
Cole, Leon J., Ann Arbor, Mich.
Dublee, J. Clyde, Williamsport, Penn.
Evarding & Farrell, Messrs., Portland, Ore.
Everman, Prof. Barton W., Washington, D. C.
Gebhardt, A. E., Salem, Ore.
Geer, Dr. E. F., St. Paul, Minn.
LeGettee, K., Centenary, S. C.
Green, Dr. D. W., Dayton, O.
Hampton, F. T., Hill City, Tenn.

Henkel, C. P., Neosho, Mo.
Hogue, William F., Marion, Ala.
Howell, John H., Auburn, N. Y.
Johnson, D. W., Hartwell, Ga.
Joslin, Hon. C. D., Detroit, Mich.
Kendall, Dr. William C., Washington, D. C.
Kennedy, Edwin M., McConnellsville, O.
Landers, E. T., Hopeville, Ga.
Lewis, Charles E., Minneapolis, Minn.
Miller, Frank, Put-in-Bay, O.
Monroe, Otis, Mill Creek, Mich.
Moody, G. C., Mill Creek, Mich.
Mullett, R. M., Washington, D. C.
North, Paul, Cleveland, O.
Palmer, W. A., Buchanan, Mich.
Paxton, Thomas B., Cincinnati, O.
Pearce, Caption T. C., Washington, D. C.
Plumb, Charles, Mill Creek, Mich.
Prendergast, Charles F., Savannah, Ga.
Rodgers, J. L., Columbus, O.
Saunders, Dr. H. G., Chattanooga, Tenn.
Simons, Max, Columbus, Ga.
Thomas, Henry G., Stowe, Vt.
VanDusen, Hon. H. G., Astoria, Ore.

Corresponding Membership:

Feilding, J. B., Holywell, North Wales.

Mr. F. B. Dickerson took the chair.

Mr. Dickerson: If there is any one thing that predominates more than another in the American Fisheries Society, it is speed and rapid work, and it is therefore suggested that we proceed with the election of new members during the absence of the president, in order that there may be no delays, and that we can begin work as soon as he arrives. It is proposed to elect these men who desire to become members, at the very outset, and justly so, in order that they may participate in our proceedings. If, therefore, any of you have any new members to suggest, will you kindly present them at once.

We have received the following letter from the Board of Game and Fish Commissioners of the state of Minnesota:

STATE OF MINNESOTA.
Board of Game and Fish Commissioners.
St. Paul, August 2nd, 1902.

Mr. George F. Peabody, Sec.,
American Fisheries Society,
Put-in-Bay, O.

Dear Sir:—

This will introduce to you Dr. Ethelbert F. Greer, who takes a big interest in everything pertaining to fish and fish culture. He wishes to become a member of the American Fisheries Society and is leaving our city to attend the meeting. If consistent, I would like him to represent our Minnesota Game and Fish Commission and anything you can do to make it pleasant for the doctor will be very much appreciated. Yours very truly,

SAM. F. FULLERTON,
Executive Agent.

I desire to propose the doctor as a member of this association. He happened to fall in with the Philistines coming down from Detroit this morning, but did not suffer any serious and lasting damage from the encounter.

(Laughter and suggestion that the suffering may come later).

Candidates for membership were then proposed and elected, whose names together with those of all others elected during the several sessions of the society appear at the beginning of the printed proceedings. President E. E. Bryant then took the chair.

President Bryant: I give you greeting and assure you of my great satisfaction in seeing so many faces that have grown familiar and dear to me, as engaged in this work. I congratulate you upon your safe arrival here, and I think in selecting the place for our meeting, the good committee who made this selection and recommended it to our society, builded better than they knew; for certainly it is a charming spot; and one good thing about it is that it is going to be a little difficult for us to get away until our meeting is over. (Laughter).

We have everything to cheer us on in this work. It is less than half a century since the feasibility of the idea of increasing the productivity of the waters was brought to the notice of men: and the result that has been accomplished in that half century is

something marvelous, and the progress of the work and the results being achieved by the states and by the United States and by the enterprising gentlemen who are entering upon this work to produce fish for the market, are something to give us especial gratification.

Another feature of the subject commends itself to our satisfaction and that is the universal confidence that is expressed by the public in our work. I see that year by year, not only as a local observation, but as manifested by the generous efforts of the legislatures of the states and by congress in forwarding and aiding the work in which we are engaged.

I hope our meeting will be as pleasant, as satisfactory, as profitable and instructive to us all as the meetings we have had in the past. Indeed, in my own experience, I may say that each meeting adds to my stock of knowledge; it increases my interest and opens up new fields of inquiry, and with the intelligent work that is being done in the direction of the propagation of fish there is surely success to be achieved. We have yet our problems and our difficulties, but one by one they are being surmounted, although there are many conditions yet to be realized to achieve all that can be accomplished. Our laws for the protection of fish are yet imperfect, public sentiment in enforcing those laws is yet feeble, and we must build up along those lines; we must not only fill the lakes and the rivers with small fish to grow to maturity, but we must so protect them that the greatest ultimate good may be achieved, and that this end may not be thwarted by wanton or lawless invasion—or too weak and feeble laws for the protection of the fish, which we have demonstrated to the world in our various fields we can produce in unlimited quantity to supply all the wants of men. We must get the laws and organized societies to join with us in securing for the public the greatest benefit that can be accomplished.

I am requested by the United States Fish Commission to give you the grand totals of their work for the year. You recollect their report last year showed an extraordinary growth and increase in their output. So far as I have been able to examine the state reports, everywhere there is evidence of increased success, larger output, broader and more generous distribution; and

the figures which will appear in the United States report soon to be published for the fiscal year ending June 30th, 1902, will show a very gratifying increase in the beneficient results of the work of the United States Fish Commission, in every line of productivity; and I am pleased to notice that whenever we write to congressmen, in behalf of the commission, to aid us, or to be helpful along the lines of supporting the United States Fish Commission, and indirectly the other commissions, they invariably reply that they are heart and soul with the fish commission and wish to render it every aid possible. We have a grand total here of a billion and a half distribution of fish during the last year, while for the previous year it was a little over a billion. This increase is shown in nearly all the lines of production, a very gratifying result, and one that gives us all encouragement to go on.

The report furnished me is as follows:

SUMMARY OF DISTRIBUTION,
1902.

TOTAL	EGGS	Fry and Fingerling	Adult and Yearling	TOTAL
Shad	.....	104,986,000	2,000,000	106,986,000
Quinnat Salmon	19,346,410	29,337,308	.....	48,683,718
Atlantic Salmon	300,000	56,765	282,000	638,765
Landlocked Salmon	200,000	523,655	98,565	822,220
Silver Salmon	.....	424,530	.....	424,530
Blueback Salmon	.....	3,371,000	.....	3,371,000
Steelhead Trout	68,000	389,196	77,686	534,882
Loch Leven Trout	.....	91,760	5,000	96,760
Rainbow Trout	397,790	784,835	492,496	1,675,121
Blackspotted Trout	280,000	100,500	1,488,500	1,868,500
Brook Trout	920,000	5,222,422	437,340	6,579,762
Lake Trout	5,235,000	22,022,478	3,012	27,260,490
Scotch Sea Trout	10,000	7,694	6,837	24,531
Golden Trout	.....	69,950	.....	69,950
Grayling	655,000	1,130,333	17,925	1,803,258
Whitefish	111,260,000	483,230,000	.....	594,490,000
Pike Perch	60,000,000	177,099,000	.....	237,099,000
Catfish	.....	.....	95,970	95,970
Pike	.....	.....	575	575
Pickerel	.....	.....	805	805
Ring Perch	.....	.....	1,700	1,700
Buffalo	.....	.....	200,000	200,000
Black Bass	.....	.....	262,157	262,157
Crappie	.....	.....	735,120	735,120
Rock Bass	.....	.....	37,170	37,170
Strawberry Bass	.....	.....	3,351	3,351
Warmouth Bass	.....	.....	100	100
Calico Bass	.....	.....	200	200
Sunfish	.....	.....	606,040	606,040
Bream	.....	.....	17,699	17,699
Cod	.....	212,001,000	.....	212,001,000
Flatfish	.....	168,133,000	.....	168,133,000
Lobster	.....	81,020,000	.....	81,020,000
Totals and Grand Total	198,672,200	1,290,000,928	6,870,248	1,495,543,374

I should be very glad if we had a brief presentment to show what had been accomplished by the various states. I can only

say in general terms that they are all making good gains and advances. With these somewhat hasty remarks, gentlemen, I will not detain you longer from the business which we are met here to transact.

Motion was then made that a committee on nominations of officers, and a committee on time and place of meeting be appointed by the chair.

Motion seconded and carried.

Mr. F. B. Dickerson offered the following resolution:

Whereas, The American Fisheries Society has on several occasions expressed its approval of the plan to establish a biological station on the Great Lakes in the interest of the fisheries, and

Whereas, A measure now pending before congress provides for the inauguration of such an enterprise, therefore be it

Resolved, That a committee of five be appointed from the society to urge the importance of the matter on members of congress and to further the plan in every legitimate way.

The President: I understand an appropriation has already been made for this purpose.

Mr. Dickerson: No. I understand the matter was brought up, and passed congress, establishing a biological station for the study of the growth and food of various salt water fish; but no such station has ever been established on the lakes for the study of the growth and food of the fresh water fish, which is a matter of great importance to the middle states. This matter was brought up in congress but failed to pass both houses, owing to a press of other business.

The President: It probably will be reached in the next session.

Mr. Dickerson: Yes, the matter simply died in committee.

Dr. E. A. Birge, of Wisconsin: Is it dead?

Mr. Dickerson: It passed one body or the other.

Dr. Birge: It was contained in an omnibus bill of the house.

Mr. Dickerson: Yes, but it did not pass both houses on account of lack of attention. My suggestion is that the president appoint a committee to watch that thing and push it at all stages

of the game at the next congress. If we had done that before we would have passed it at this last congress.

Motion made, seconded and unanimously carried, adopting the resolution.

Mr. Dickerson: I want to apologize for doing three days' work in one, because I expect to have to leave tonight or at 5 o'clock tomorrow morning, owing to business matters at home requiring my attention.

It seems to me there is one matter which this association has always neglected and that is the matter of creating a public sentiment in favor of fish culture. We began in Michigan a year and a half ago in a systematic way to educate our people in the state in the interest of fish culture; we have already profited by it; it is a matter that has never been discussed by this association, a matter that has never been taken up, and we ought to devise some way of systematicially educating the public in favor of fish culture. Every state where fish culture is carried on to any extent needs attention in that direction. When a farmer comes to the legislature, if fishing in his immediate vicinity is of no great importance, he looks on raising little fish as child's play; he votes against the appropriation because he does not see any need for the work in his own neighborhood; he takes no interest in the matter. The opposition in our legislature comes from those gentlemen who live in districts where there is no water in their immediate vicinity and where they derive no direct benefit near their homes from an appropriation in the interests of fish culture; and for that reason, to properly conduct the work (and we cannot conduct it properly unless we get sufficient appropriations with which to conduct it) it is necessary, in my judgment, to begin in asystematic manner to make public sentiment in the interests of fish culture; and I want to suggest that that matter be discussed here so far as it possibly can, and I will offer a motion that the chair appoint a committee to recommend at our next meeting the best method or methods of interesting the public and creating public sentiment in favor of fish culture.

Motion seconded.

Mr. George F. Peabody, of Appleton, Wis.: I think Mr. Dickerson's idea is a very excellent one, but still the initiative

must be taken by the state fish commissions in their work in each state. They are the men to educate the public, and they can only do it by intelligent work, each commission in its own state. Now, Michigan stands in the front rank, and I am proud to say that Wisconsin is a close second (modestly, I say, a close second) and the state of Wisconsin is educated to this point; and people send for fry, as General Bryant knows, from all over the state. Farmers want them and are generally friendly to the work of the commission in the state of Wisconsin; and each year, as the president indicated in his opening address, there is more and more to encourage the work of this society. Now, it seems to me that this society cannot do this work exactly as Mr. Dickerson suggests; it is a very excellent idea to bring it up, however, and have it discussed. But it is the business of each state commission to undertake this task. How many states have we represented here? Just a handful! Here is the great state of Ohio. How many Ohio men are there here, although the meeting is held right in its own waters?

Mr. Dickerson: They have no water in Ohio.

Mr. Peabody: They have lots of it around here, yet they are not represented. Massachusetts has one representative here, Vermont none, New Hampshire none, and the great state of Maine none. Those are the people to do this work. This society can merely discuss these matters and make investigations and promote an interest through its members, but the fish commissions of each state are themselves to blame in this matter, if they lie down and stay away from these meetings and take no interest in them. I do not think it is the province of this society to chase them up very much.

It seems to me that the scope of this society is to go on as it is doing in original investigation and in discussion of methods of propagating fish and all that sort of thing. It is throwing a brilliant light on the subject of fish culture, each year more widespread. This season, as secretary of the society, I have had applications from foreign countries and from all over the United States, and from men whom you would think were not interested especially in this work, for the printed transactions of the society, and that indicates that the interest is growing and is widespread. I think the thing to do is to get at the state fish com-

missions, get at the governors and have them appoint commissions like the fish commissions of Wisconsin and Michigan, Rhode Island and other states which are enthusiastic and interested and will promote education as suggested in the resolution.

Mr. Dickerson: I agree exactly with Mr. Peabody. We in Michigan have known that you have more sentiment in favor of fish culture in Wisconsin than we have had in Michigan, until within the last eighteen months. Now, Mr. Peabody has made an excellent argument for my motion. I am sure that the gentlemen from Connecticut, Ohio and from every other state, would like to know in what manner and how you builded that sentiment in Wisconsin. If you have made that sentiment in Wisconsin how did you make it? We in Michigan want to know; I am sure my Connecticut friends want to know, and Ohio wants to know. Now, my suggestion is that you appoint a committee to see if the methods successfully used in one state to build up this sentiment cannot be used in another. You let a genius connected with any of the great railroad systems devise some scheme in California for the benefit of that railroad system, and it is immediately put in operation, and every office on the entire line of that system is made to feel it. Now, if the genius of somebody has builded a sentiment in Wisconsin that helps the work in that state, why should not every other state receive the benefit of his ability.

Mr. John E. Gunckel, Toledo, O.: My friend Mr. Dickerson had in mind only Ohio, when he made the motion and the able argument in favor of something that I think ought to be done. He knew very well that for the last fifteen years I have been about the only representative from Ohio at these meetings. I am not a fish commissioner, I know nothing about the hard work that my friend Mr. Clark does, but I was originally acquainted with the man who first introduced the propagation of fish, the late Judge Potter. As long as our companions and associates are all right, that makes a man solid and square. Ohio has done nothing for a number of years; but from the information that I gleaned during the last fifteen or twenty years by attending these meetings, I went home and in my back yard I tried a new plan, the culture of the fish tree, in which I have been quite successful.

I am glad to say that I have been able to supply northwestern Ohio. Since Mr. Stranahan left Put-in-Bay, something had to be done. We used to snake our fish from Stranahan, but now we get nothing! I strongly favor a committee to be appointed to wake up Ohio and other states similarly situated.

The fish commission amounts to nothing, (I do not wish the stenographer to miss that either) because it is merely a political plan from beginning to end, and you must do so and so or it don't go. Now, if there is some influence brought to bear that will lift this state out of the hole or rut into which it has fallen, it will be a blessing, and this committee can certainly lay plans as to how it shall be done. If they cannot get the fish commissioner to do something, they can back up the people; and the people are ready at any time. There never was a time in the history of the state of Ohio when the laws were so good for the protection of fish as this year, there is no question about that. All that Ohio needs is a few good men right behind it, men of experience and men that have been educated in the American Fisheries society, that will push Ohio to the front. I am strongly in favor of Mr. Dickerson's motion.

The President: The chair is inclined to commend your energy in increasing the number of fish in Ohio by introducing the new method of raising them on trees.

Mr. Gunckel: I had to do it, and then they called me a liar. (Laughter and applause). So I started to raise boneless fish, and I have succeeded, I am happy to say, in that also.

The President: I would inquire of Mr. Dickerson what is his precise motion.

Mr. Dickerson: My motion was that a committee of three be appointed to suggest to the various state commissions, or to report at our next meeting, the best method of creating public sentiment in the various states in the interests of fish culture.

Motion seconded and unanimously carried.

Mr. John W. Titcomb, of Washington, D. C.: I move that we adjourn at 5 o'clock for the afternoon session. My object in making that motion is simply to ascertain whether the members would like to take a boat ride, and if so that motion might be made conditional on the weather. The fish commission steamer

Shearwater will take those who wish to go on a little ride around the lake.

Motion seconded and carried.

Mr. Peabody: Prof. Jacob Reighard has a lecture to deliver tonight, or at any time when it is convenient for the society, illustrated by the stereopticon, and it might be well to consider that matter before the adjournment.

Prof. Reighard: The only point about this is, that if this lecture is to be given with the lantern it will be necessary to make arrangements with the electricians for the connections, so that I will have to know in advance when it is to be given.

Mr. Titcomb: I move that the lecture be given here tonight at 8:30 o'clock, if agreeable to Prof. Reighard, and that the public be invited to attend.

Motion seconded and unanimously carried.

Prof. Henry B. Ward, of Lincoln, Nebraska, then read a paper by Dr. R. H. Pond, of Michigan, on the subject, "The Role of the Larger Aquatic Plants in the Biology of Fresh Water."

The president appointed as a committee on program, Mr. Titcomb, of Vermont, Mr. Peabody, of Wisconsin, Mr. Root, of Rhode Island, Mr. Fox, of Ohio, and Mr. Pike, of Connecticut.

Mr. Clark: I think we should now hear the secretary's report.

Secretary Peabody: The printed transactions constitute the secretary's report. Aside from that I have no other report than that which I have read. The printed report of the discussions has been sent to all the members and to applicants for membership. The work of the secretary is embodied in that report, and as far as finances are concerned, is contained in the treasurer's report.

The treasurer's report was then presented as follows:

Westerly, R. I., Aug. 5th, 1902.

To the American Fisheries Society:

Gentlemen:—

I beg to submit herewith my annual report as treasurer from July 18th, 1901, to August 5th, 1902.

RECEIPTS.

Balance in treasury	$165.09	
Yearly dues and fees	228.00	
Six copies of reports sold	1.50	
Interest on deposit in bank	2.85	$397.44

EXPENDITURES.

1901.			
July 20.	J. W. Titcomb, sundries at Milwaukee	$ 9.50	
Aug. 3.	S. Bower, Sec., sundries at Milwaukee	5.80	
Aug. 3.	Stamps and envelopes	7.74	
Aug. 10.	H. D. Goodwin, stenographer, by Sec	82.00	
Aug. 21.	Express on papers	.25	
Aug. 21.	Receipt book	2.87	
Dec. 10.	Post Publishing Co., by Sec	138.00	
Dec. 10.	R. B. Hoyler & Co	2.95	
Dec. 10.	Geo. F. Peabody, Sec., sundries	20.04	
1902.			
Jan. 1.	100 stamped envelopes and receipts	2.42	
May 25.	100 stamped envelopes and receipts	2.52	
July 1.	100 stamped envelopes and receipts	2.12	
July 25.	Ryan & Co., Appleton, Wis., by Sec	10.25	
July 25.	Geo. F. Peabody, Sec., stamps, etc	9.84	
		$296.30	
	Balance cash on hand	101.14	$397.44

Depository of funds, Manufacturers Trust Company, Providence, R. I.

C. W. WILLARD,
Treasurer.

Mr. Willard:—I should like to have the report referred to an auditing committee.

The President: I will appoint such committee at the request of the treasurer.

On hearing the report of our good treasurer and noticing that he accounts for interest on deposit, reminds me that it was told historically, I believe, that the great William Pitt when he was made paymaster of the forces, the general understanding being that he was to have the interest on deposits as part of the perquisites of his office, with stern honesty accounted for every cent of the interest as well as principal; and a great many people of England thought that he was foolish to do it. The great Edmund Burke, also made paymaster of the forces for the purpose of enriching his purse, was so strictly honest that he ac-

counted for the interest on the deposits; and I am glad to find that our good treasurer, with the same sense of fidelity and loyalty to our fund, has accounted for the interest, and deserves especial commendation for his frugality and financial wisdom in investing our funds so that they yield an income.

Mr. Peabody: A large number of letters of regret have been presented, also excuses for not furnishing papers, and I suppose it is unnecessary to read them all, but there is one from Mr. E. W. Blatchford to which I should like to refer. A great many of you remember him at Wood's Hole. He was very much interested in the matter of a monument to Prof. Baird; and the latter part of his letter is of interest as pertaining to that subject. He says:

"The 'Baird Memorial Committee' are engaged in preparation for the dedication of the admirable granite boulder and tablet in Prof. George Baird's memory—the large and thoughtful work connected with which has been done by our honored chairman—Dr. Smith."

Mr. Gunckel: I may be fishing in water where I cannot land the fish, but at least I can cut bait. I would respectfully suggest a change in the constitution and by-laws as follows: Make present Article 5, Article 6, and then add Article 5 which shall read as follows:

"Order of business shall be as follows:"

(You all notice the trouble that we have in the order of business).

"First: Call to order by the president.

"Second: Roll call of members.

"Third: Application and action on new members.

"Fourth: Reports of officers, president, secretary and standing committees.

"Fifth: Appointing committee of five to nominate officers for ensuing year.

"Sixth: Appointing committee of three on time and place for next meeting.

"Seventh: Appointing auditing committee of three.

"Eighth: Reading of papers and discussions on same.

"N. B.—Preference to reading papers shall be given to members present, and in order of notices received by the secretary.

(I did not prepare a paper this time, because I thought as you met in Ohio, it would be a matter of respect to the other states that Ohio should give way to the distinguished gentlemen from abroad. A man who comes 500 miles to attend our meetings and has given notice that he is going to read his paper, should be entitled to first attention and a full house).

"Ninth: Payment of annual dues."

I respectfully submit this for your consideration, and only suggest it because I think it may be something that will lead us to firmer ground.

Mr. Peabody: I move that this matter be referred to a committee of three.

Motion seconded and carried.

Mr. Clark: I move that the secretary be instructed, if necessary, to mail a copy of the present printed report to all new members.

Motion seconded and unanimously carried.

Secretary Peabody: I have sent them to all of the members that we have received during the year, and there are enough to go around now.

Mr. Titcomb: I would say in connection with this that a resolution was passed at the meeting at Wood's Hole, providing for the sale of back copies of the transactions, so far as available, to those wishing to complete their files. I simply call attention to the matter.

Dr. Reighard: Are there complete sets?

Secretary Peabody: No, there are no complete sets.

Mr. Frank N. Clark, of Michigan, then presented a paper on the subject, "A Successful Year in the Artificial Propagation of the Whitefish."

The president appointed as committee on nominations and selection of place of meeting: F. N. Clark, of the United States Fish Commission, Dwight Lydell, of Michigan, J. J. Hogan, of Wisconsin, G. T. Mathewson, of Connecticut, and H. B. Ward, of Nebraska.

As committee to urge upon congress the importance of establishing a biological station on the great lakes, F. B. Dickerson,

of Michigan, Jacob Reighard, of Michigan, E. A. Birge, of Wisconsin, J. E. Gunckel, of Ohio, R. T. White, of New York.

Prof. Reighard: Arrangements have been made for the reading of my paper accompanied with stereopticon views, in a large assembly room of the hotel, at 8:30 o'clock tonight.

While I am on my feet I wish to present to the society Mr. Dickerson's excuses for leaving, but pressing private business required him to return home this afternoon.

Adjourned to 8:30 p. m., same day and place.

EVENING SESSION, 8:30 O'CLOCK.

Meeting called to order by the president.

The President: You all probably know that our appointment this evening to hear the lecture of Dr. Reighard failed because of lack of electric current to operate the lamp to be used, and so we have concluded to spend the evening in the regular business of the society, taking up the reading of papers and receiving reports of committees.

The chairman of the program committee then presented the following report: The committee on program were unanimously decided that the day's session should begin at 9:30 a. m. and last until 12, and begin in the afternoon at 2:30 and last until 5; that the papers of those who were present should be read in preference to the papers of those who are not here to read them personally; and the idea was that the bass papers should be grouped and all read at one session. The plan was to have the bass papers in the morning, and talking with the committees separately about this meeting tonight, it was thought that if the members present desire to continue, the trout papers might best be taken up tonight, one by Mr. Seagle and one by Mr. Marsh. Tomorrow afternoon after the session, if the members desired, there could be another trip on the Shearwater, which in fact is at the disposal of the members at any time.

Report of committee unanimously adopted and committee discharged.

Mr. M. C. Marsh then read a paper on the subject of "The Brook Trout Disease and Cement Ponds."

Mr. George A. Seagle, of Virginia, then read a paper on the subject, "Some Remarks on the Rainbow Trout, the Time for Planting, etc."

Mr. J. J. Stranahan, of Georgia, then presented a paper on the subject, "Fish Culture on the Farm."

(Read by Mr. Titcomb).

Adjourned to 9:30 a. m., Wednesday, August 6th, 1902, same place.

Wednesday, August 6, 1902.

MORNING SESSION, 9:30 O'CLOCK.

Convention called to order by the president.

The president appointed as a committee on proposed amendment to the constitution, Mr. Gunckel, of Ohio, Mr. Pike, of Connecticut and Mr. Stranahan, of Georgia.

Dr. Bean: I would like to extend an invitation to the members of the American Fisheries Society to consider the advisability of holding the meeting in 1904, at St. Louis, at the time of the exposition. I am well aware that the last meeting of the American Fisheries Society held in Chicago in 1893, was not in every respect as satisfactory as it might have been, for reasons with which doubtless many of you are entirely familiar. There was strife at that time; there is none now. In the year 1904 the United States government will, I have no doubt, make the finest display both in fisheries and fish culture which it has ever made, and there is a perfect understanding between the authorities of the exposition and the authorities of the United States Fish Commission, so that both will work harmoniously, intelligently and enthusiastically, with the object of bringing together not only interesting displays, but discussions of fish culture and fishery subjects. I suppose this meeting would be held at a time of the year which would be agreed upon by the society.

St. Louis has the reputation of being a very hot city in summer. I have spent the present summer there, and it is the first summer I have spent in any city in twenty-five years, and I have suffered far less than I have in Washington at the same time of

the year. It is a cool year, I know, but 1904 may be another cool year. In ordinary years the temperature of St. Louis is much more endurable than that of a great many of the eastern cities. I have lived in New York for a good many years and am a resident of New York now, and when I say that St. Louis has treated me more kindly in the matter of comfort than New York City, you may be surprised, but it is nevertheless true.

In St. Louis, as I said, the government will have a very large display of live fish and of fishery appliances, and in addition to that the foreign governments will come in and show what they can do in the way of fish culture and oyster culture. While, of course, in some respects we have very little to learn from the foreigners, yet in other respects, especially in oyster culture and in the handling of lobsters and other crustaceans, we have a great deal to learn from the Europeans—and they will be there. Their space is already engaged, and we shall have their representative men in fish culture as well as in fishery.

Now, St. Louis is one of the most important places in the west, not only as a fish market, but as a city in which fishing interests are enthusiastically considered. I believe that I have never found a city of its size which contained so many intelligent fishermen. It is a singular thing that the state does not reflect the sentiment of St. Louis. I suppose it is because the state officers, the commission, may be politicians—that I don't know. I am not interested at all in politics, but I have found that whenever a commission does run into politics there is very little work done except that which will serve the politician's purpose, and I can account for it only in that way. Aside from that, St. Louis is really a remarkable place as a fish center, that is to say, a market for fresh and preserved fish, as a place from which anglers go out to catch fish and study fish. Therefore, gentlemen, I hope that you will look over this matter favorably and decide next year to hold your meeting in St. Louis. You will be very welcome and the exposition authorities will do everything in their power to make you comfortable and happy.

The secretary then presented the following letters:

St. Louis, Mo., July 24th, 1902.

Mr. J. E. Gunckel, Corresponding Secretary,
The American Fisheries Society,
Toledo, O.

Dear Mr. Gunckel:—

I have seen the announcement of the meeting of the American Fisheries Society to be held at Put-in-Bay, August 5th to 7th. I wish I could be with you, and possibly I may be there. I am writing you now to ask your co-operation in securing a meeting of the society at the Exposition in St. Louis in 1904. Of course it is a little early to pass a resolution on this subject, but not too early to agree informally, at least, to such a course. You know that meetings of fishery societies at international expositions have always been extremely interesting. The Exposition authorities will welcome you, and you will be provided with a suitable place in which to hold sessions.

Will your state do anything about a fish exhibit at St. Louis? I am sending you, herewith enclosed, some copies of the first circular of the Fish and Game Department. I also have charge of the Forestry Department as Acting Chief. Kindly write to me as soon as convenient and let me have your assurance of sympathy and co-operation.

Very truly yours,
TARLETON H. BEAN.

THE FISHING GAZETTE.
G. E. Jennings, Publisher and Proprietor.
203 Broadway.
New York, August 4th, 1902.

Mr. George F. Peabody,
Secretary of the American Fisheries Society,
Hotel Victory, Put-in-Bay, Ohio.

My Dear Mr. Peabody:—

I regret exceedingly that I cannot be with you, for owing to sickness, etc., I find it necessary to remain in New York during the month of August. I am, of course, greatly disappointed, for I had anticipated a pleasant outing with you all on Lake Erie. However, I shall have to postpone my meeting with you until next year, when I hope the meeting will be held in an eastern city.

I returned from Halifax on Friday and stopped at Boston on my way and called upon Capt. J. W. Collins, Chairman of the Commissioners of Fish and Game of Massachusetts, who was at one time a member of the society. I suggested that it would be a graceful act to invite the society to hold their next meeting in Boston, but Captain Collins very modestly said that he was not in a position to do so, but I feel sure that if Boston should be chosen the members from that city, particularly John R. Neal, who is one of the most prominent fish merchants in the United States, and Mr. Jay Smith and I think also Captain J. W. Collins, would be only too willing to

make it pleasant for the members. I feel quite sure that if the meeting should be held in that city, I could get a number of prominent business men interested in the society and enlarge the list by a number of new names.

This, of course, is all subject to the committee on location—merely a suggestion. Boston is well located for an outing for the western members, who are fond of the sea and its products, and convenient to a number of well known seaside resorts, and I think it would be well to consider having the meeting there next year.

Trusting the present meeting will be a big success and wishing to be kindly remembered to all, I remain,

Yours truly,

G. E. JENNINGS.

Mr. Titcomb: I do not think it is wise to begin the discussion of papers on black bass until more members are present, and I do not like to appear on the floor too often, but as a little tribute to the scientists of the commission I want to read a little squib which I see comes from the London Chronicle:

THE LOBSTER HATCHERY.

Nature grim, in remorseless mood,
Undoes the work that she has done,
And out of every lobster brood
Slays ninety-nine and keeps but one.

Art stretches o'er the horrid scene
Her skillful and remedial sway—
And when I speak of "Art" I mean
The Fish Commission, U. S. A.

It takes the tender lobsterlet,
And gives him food and kind advice,
Changes his boots if they are wet,
Brushes his hair and makes him nice.

And lo, this baby of the sea
In gratitude begins to thrive;
Where one per cent it used to be,
Fifty, all fat, remain alive.

O noble work, heroic, grand,
That saves in scientific ways
Those little lisping lobsters, and
Keeps them for me and mayonnaise.

Mr. Gunckel: The committee on amendment of constitution and by-laws is ready to report.

The President: We will hear their report.

The report was then read by the secretary as follows:

AMENDMENT TO CONSTITUTION AND BY-LAWS.

New Article: Order of Business.
Instead of present Article No. V.

ARTICLE V.

ORDER OF BUSINESS.

1. Call to order by the president.
2. Roll call of members.
3. Application of new members.
4. Reports of officers.
   a. President.
   b. Secretary.
   c. Treasurer.
   d. Standing Committees.
5. Committees appointed by the president.
   a. Committee of five on nomination of officers for ensuing year.
   b. Committee of three on time and place of next meeting.
   c. Auditing committee of three.
6. Reading of papers and discussions of same.

(Note—In the reading of the papers preference shall be given to members present and in the order of notices received by the secretary).

7. Adjournment.

Dr. Birge: I move the adoption of the committee's report. Motion seconded.

Dr. Birge: I should like to ask a question. This is a substitute for Article V?

Mr. Gunckel: Article V becomes Article VI. I thought that the secretary would understand that. Article V is an amendment to the constitution.

Dr. Birge: May I ask in what way the constitution can be amended?

Mr. Gunckel: At any time by a vote of two-thirds of those present, provided fifteen are present.

Dr. Birge: My own feeling is that unless it is very easy to get away from it, it is not advisable to tie ourselves up to an order of business from which we cannot depart pretty readily. I notice, for instance, one thing in this proposed amendment which I feel sure the society will want to change quite frequently, and that is, that the papers are to be read in the order in which notification is received by the secretary. Certainly if we have a group of papers on a given subject, as we had last night on the trout, and are expecting to have today on the black bass, I suppose it would be frequently, at least, the wish of the society that the papers connected in subject should be read together, rather than scattered around and sandwiched in with papers that have no relation to them.

Mr. Titcomb: I concur with Prof. Birge on that part of this amendment. It seems to me that the order of the reading of the paper should be decided by either a committee or the officers who have charge of the meeting, and if this rule is adhered to we would not have our papers grouped in the order they ought to come. For illustration, today, by your committee on program, it was suggested that we take all of the day's papers at one session, and very frequently a man comes a long distance and is interested in bass, or is interested in trout. Now, he would like to hear everything on that one subject during one session; he may have to go away. I think further while talking on this subject, though it may not be entirely about that resolution, that we ought to have a committee to whom all papers should be submitted, and let them decide whether those papers are all to be read. We may have some paper that we do not want published by the American Fisheries Society. Some crank may read a paper which does not do the society credit. We might get some stuff into our pamphlets that would not do us credit when sent broadcast through the world as our pamphlets are; and a committee could look them over and be a sort of a censor body perhaps. I object to that clause. I think if that note was simply omitted, then we can suspend rules any time to carry out Prof. Birge's idea, and we would not be tied up in that particular part of it. I think we ought to have an order of business.

The President: The sixth order of business is reading of papers and discussion of same, and to this is appended a note as follows: "In the reading of papers preference shall be given to members present and in the order of notices received by the secretary." The suggestion is that the note be stricken out.

Mr. Gunckel: If you will allow me, of course it is generally known that if I can slip in a paper occassionally it doesn't amount to anything—I admit that—but being in the position that I am and not of a scientific nature, except what I can glean from these meetings, I would say that this suggestion does not come originally from me, but from a great many members present who read papers nearly every time. You have twice, I think, carried motions, to the effect that gentlemen who are present shall have the preference of reading their papers over those who are absent; and this is the first time since I have attended any of the meetings where you have divided papers off into groups. That, of course, would naturally change the preference that I have inserted there, but certainly a man who has come 400 or 500 miles and whose time is limited ought to have the preference in reading his paper over one who is not present, but who has sent his paper in, thus perhaps delaying the paper of a man who is present until too late to read or discuss it. It is unfair. That is the argument, and I strongly think that that note of preference there should be given to the writers of papers who are present. You can divide the papers up into groups or in any way you wish, but the men who are present certainly should have the preference.

Then again, if I get up at 5 o'clock in the mornings and study for a whole month and prepare a scientific article and I come here to read it and want to discuss the subject, I am certainly entitled to the presence of a majority of the members. Some of you members have spent a lifetime in propagating fish and learning the secrets of their movements and everything, and it is not fair to a man who comes a great distance to be put back to the last in favor of some one who has sent in his paper late.

Dr. Birge: I think you misunderstand my point and that of Mr. Titcomb. The thing I objected to was in regard to the papers being read in the order of notices received by the secretary. I am ready to agree that the members present should have

the preference in the matter of reading papers; that is the ordinary custom in societies; but I should strike out that last part. The fact that I give notice of preparation of a paper three months ahead ought not to put my paper on the first session as against the man who sends in his notice one month ahead.

Mr. Gunckel: The man that gets up in the morning and sends in his article first pleases the secretary. The man that is late, sneaks in and hands an article to the secretary and says he has prepared it since he has been there, should not be allowed to read his paper first. I say the man who got here early should be recognized first.

Mr. Titcomb: I think, as Dr. Birge says, we are all agreed that the people who are here should have the opportunity to read their papers in preference to those presented later, but I think we ought to have some system about grouping our papers, and if we adopt the note as it now reads, we are going to get, perhaps, a paper on trout culture the first part of the session and then take up a paper on trout culture again the last part of the meeting. I think all kindred subjects should be taken up together, just as we take up the bass question this morning.

Mr. Gunckel: Then strike out the words "in the order of notices received by the secretary."

Dr. Reighard: I move to amend the report by omitting that clause which refers to the papers being read in the order of notices received by the secretary.

Motion seconded.

The President: That will leave liberty of adjustment and grouping of papers at the meeting.

Unanimously carried.

The President: The amendment to the constitution, as amended, by adding Article Five and changing the present Article Five so as to read Article Six, is now before you, as amended.

Mr. Clark: The committee are ready to report on officers and place of meeting.

The President: We will receive the report.

Prof. Ward: I should like to move that it be the rule of this society that the officers shall be empowered to group and arrange the papers for the session, constituting them practically

a committee for that purpose, and enabling them to do it a little in advance of the time of the meeting. I propose that as a standing rule.

Motion seconded.

Mr. Titcomb: Do you wish to include all of the executive committee? I think if it is left to the president and secretary you will have the thing done more quickly than if you wait for all the officers to get together.

Mr. Ward: I will accept the suggestion, making it a committee of three, the president and the two secretaries.

The President: Will you state the motion again?

Prof. Ward: That the president and the two secretaries be empowered to arrange and group the papers for the programme of the meetings of the society.

Mr. Gunckel: We have had motions similar to that and we always forget them. Now, why can't you make that part of Article Five of our constitution and by-laws, right after the article we have discussed here, and then it will always appear in our report. We have no back reports here. There are a lot of motions which we have forgotten all about. There is one made in New York a few years ago, and you have forgotten all about that.

Prof. Ward: I will gladly do that if it can be adopted constitutionally. Now, I should be glad to accept the suggestion and make it Section 2 of the present article.

Mr. Gunckel: I would suggest that under Rule 6 this proposed amendment shall be noted as Section "b."

Dr. Birge: I would suggest that the words, "and group" be omitted. The power to arrange is sufficient.

Prof. Ward: I will accept the suggestion.

The proposed amendment to the constitution is that the president and the two secretaries be empowered to arrange the papers of the meetings of the society, and that that be added to Article 5 as Clause "b" of the constitution just amended.

Seconded and unanimously carried.

The amendment to the constitution as finally adopted is as follows:

AMENDMENT TO CONSTITUTION AND BY-LAWS.

New Article: Order of Business.
(Instead of present Article V.)

ARTICLE V.

ORDER OF BUSINESS.

1. Call to order by President.
2. Roll call of members.
3. Applications for membership.
4. Reports of Officers.
   a. President.
   b. Secretary.
   c. Treasurer.
   d. Standing Committees.
5. Committees appointed by the President.
   a. Committee of five on nomination of officers for ensuing year.
   b. Committee of three on time and place of next meeting.
   c. Auditing committee of three.
6. Reading of papers and discussions of same.

(Note—a. In the reading of papers preference shall be given to members present.
b. The President and the two secretaries are empowered to arrange the papers of the meetings of the society).

7. Miscellaneous business.
8. Adjournment.

Mr. Clark: Without taking up too much time I will state that the committee on time and place have had under consideration the invitations from different points, very cordial ones from Niagara Falls, Buffalo, Wood's Hole and Mill Creek, Michigan. Those presenting the names of these different cities (especially Mill Creek) have invited the society very cordially. Mr. Tuttle presented the Niagara Falls matter, and they are all good places —no question about it—but the committee have decided to make the following report:

After carefully considering the invitations from the several

cities, we respectfully suggest that the next annual meeting be held at Wood's Hole, Massachusetts, on Tuesday, Wednesday and Thursday of the fourth week of July, 1903, namely the 23rd, 24th and 25th of July, and that the meeting be called to order at 2 p. m. on Tuesday. It is further suggested that the place and time be printed on the letter heads usually furnished by this society.

They also wish to report as their suggestions for officers for the year:

President—George M. Bowers, Washington, D. C.

Vice President—Henry B. Ward, Lincoln, Neb.

Recording Secretary—George F. Peabody, Appleton, Wis.

Corresponding Secretary—John E. Gunckel, Toledo, O.

Treasurer—C. W. Willard, Westerly, R. I.

Mr. Peabody: I would like to say that it will be impossible for me to act next year. As I am planning now, I may be out of the country; and further, I think it was rather understood that we were to take turns at this thing, and it is quite a responsibility and quite a duty. If my memory serves me right, I think it was understood that one year's service entitles one to be retired from that position, and I will ask you to substitute some one else for that office.

Mr. Gunckel: Naturally the corresponding secretary follows suit. Of course the corresponding secretary's duties are not very laborious—a little correspondence from the east and west—but I think as that is more of an honorary position, that you ought to change and have some other person. It is not very important to me, because there is little to do, but I think you ought to follow the rule and change. Of course the committee thought it a matter of delicacy and did not like to put me out in the cold world, but I will be very glad indeed if the committee will withdraw my name and put some other person there.

Mr. Titcomb: I rise to a point of order. There is nothing before the meeting.

The President: The rule of the American Fisheries Society is, no flunking. The point of order is sustained.

Mr. Clark: I move the adoption of the report of the committee.

Motion seconded.

Mr. Clark: Mr. Peabody makes a statement that I hardly think he is warranted in making. I do not remember that at the meeting at Milwaukee anything was said about the secretary's serving but one year. I think if he goes out serving as secretary of this society only one year, that it will go to the world that this society did not think much of his work, and I for one wish to say emphatically that Mr. Peabody has made one of our best secretaries, and we have had good secretaries before him; but I really think that Mr. Peabody should reconsider what he has said. If Mr. Peabody is going to be gone the whole year, why his excuse might avail, but I hardly think that Mr. Peabody will be gone out of the United States for a whole year; I think he is too much of an American for that. He may go away to Europe for a month or two, but he will come back with renewed vigor, and can serve this society better than he has in the past, if that be possible; and I therefore hope the society will not consider his remarks.

(Voices: Question! Question!)

The report of the committee was unanimously adopted, with the exception of the vote of Mr. Gunckel, which was cast in the negative.

The President: The noes are out of order.

Mr. Gunckel: I wish to make one statement to the members. I would like to have them remember that the corresponding secretary has nothing to do with sending out the books. A great many letters come to me that should go to the recording secretary. Now, all questions on scientific subjects go to the recording secretary, all questions and problems of angling go to the recording secretary. To get truthful stories, go to the recording secretary, but if you want to learn how to lie, that matter is within the province of the corresponding secretary, and all information will be cheerfully furnished by him. (Great applause and laughter).

The President: He takes charge of the Department of the Imagination.

Mr. Gunckel: Yes, sir, I take charge of that.

Mr. Peabody: I have a letter here that one of the gentlemen from Ohio wishes me to read, as it is perhaps a defense of and

an apology for the state of Ohio having no representative of and from their commission. I presume that is his purpose. There are on this letter head the names of the president and four members and two officers, but none of them is present.

STATE OF OHIO.
FISH AND GAME COMMISSION.

J. L. Rodgers, President, Columbus.

Paul North, Cleveland. Thomas S. Paxton, Cincinnati. Dr. D. W. Greene, Dayton. Edwin M. Kennedy, McConnelsville. J. C. Porterfield, Chief Warden, Columbus. George C. Blankner, Secretary, Columbus.

Columbus, Ohio, August 4th, 1902.

S. W. Downing, Supt.,
U. S. Fish Hatchery,
Put-in-Bay, Ohio.

Dear Sir:—

I had fully intended being present at the meeting of the American Fisheries Association at Put-in-Bay this week, but I find now that I am called away by an important matter and that it will be absolutely impossible for me to get back in time to attend. Please accept my thanks for your kind invitation and my sincere regrets that I cannot be present.

Wishing you a most successful meeting, I am,

Yours very truly,
J. L. RODGERS,
President.

Mr. Gunckel: That, coming from the Ohio Fish Commission, shows the first recognition the American Fisheries Society has had since 1890 from the commission, and I would make a motion that the secretary, or corresponding secretary, write officially to them, thanking them for recognizing the association, and insisting on the state of Ohio taking a greater interest in the association than it has.

Mr. Downing : I would like to correct the statement in regard to the first recognition; I think the first recognition was yesterday when I put in six dollars for the members from the Ohio Fish Commission.

The President: I think it would be well for the society to recognize that we have been hospitably entertained on the soil of Ohio, and let it go at that, and not make any record of the fact that we missed them.

The president here appointed as a committee to audit the

treasurer's accounts Mr. Lane, of Massachusetts, Mr. Geer, of Connecticut, and Mr. Downing, of Ohio.

Mr. Titcomb: I wish to extend to the members of the society an invitation to attend the Rhode Island clam bake in connection with their visit to Wood's Hole next year, and the wives of the society members are also invited to partake of this clam bake. You will remember very pleasantly the clam bake we had in connection with the last meeting.

The President: I remember it very well. I can hardly wait for next year.

Mr. Clark: There was one thing in the report of the committee on place that was left out. I beg to have it put in. Mr. Dickerson, through Mr. Ward, extended a cordial invitation to this society to meet in Detroit in 1904, and he was very anxious to make this request now, so that the members could be considering it. I understand that Mr. Dickerson offers to provide a special mail train and special mail bags for each society, or something like that, and take them all over the state.

The President: Are there any further remarks on the paper read by Mr. Stranahan last night?

(No remarks).

Mr. Titcomb then read a paper by Mr. Dwight Lydell on the subject, "The Habits and Culture of the Black Bass."

Mr. Herbert D. Dean, of the United States Fish Commission, Neosho, Missouri, then read a paper on the subject, "Discouragements in the Culture of Black Bass."

Mr. Titcomb: After the discussion on this paper, if there is any, there is a very short paper simply asking questions on bass. If the audience have the patience I should like to see this whole bass matter straightened out this morning. Mr. Clark also has a paper from Mr. Lamkin, the fish culturist, in Georgia.

Mr. Clark then read a paper by Mr. J. B. Lamkin on the subject, "A Few Points on the Black Bass for Discussion."

Mr. Clark then read a paper by Dr. James A. Henshall on the subject, "Food and Game Fishes of the Rocky Mountain Region."

Motion was made, seconded and carried that the discussion of the paper be postponed until the afternoon session.

A recess was taken until 2 o'clock, same day and place.

AFTERNOON SESSION, 2 O'CLOCK.

Meeting called to order by the president.

The President: I regret to be obliged to announce that Prof. Reighard's paper on "The Meaning of the Secondary Sexual Characters of Certain Fresh Water Fishes," and Prof. Reighard's and Prof. Ward's paper on "A Method of Measuring the Efficiency of Quantitative Plankton Nets" cannot be presented this afternoon for the reason that they were unable to make arrangements to get the current to enable them to exhibit the lantern slides.

The secretary, Mr. Peabody, then read a paper by Mr. W. T. Thompson, of New Hampshire, on the subject, "Feeding—Its Effect on Growth and Egg Production."

The President: It affords me great pleasure to announce that Hon. George M. Bowers, United States Fish Commissioner, is fortunately with us. He arrived this noon, and as we have done ourselves the honor of electing him our president, I earnestly request Mr. Bowers to come forward and let me introduce him to the society. (Applause).

Mr. Bowers: Mr. President and gentlemen, I very much appreciate the honor you have conferred upon me, but from the fact that I am not a speechmaker and that I do not desire to delay the business of this society, and from the further fact that quite a number of its members are anxious to leave on the 3:15 boat, I simply at this time again express my thanks and hope to show my appreciation for this honor by endeavoring to do, as I try to do always, my duty. (Applause).

The President: Mr. Bowers' efforts in the line of fish culture have elicited the warmest approbation from people throughout the country interested in that subject, and it will give me great pleasure to deliver the baton of office into his hands when I am through with it this afternoon.

The committee appointed to audit the treasurer's report then

presented their report, finding that the treasurer's report was correct.

Report adopted.

Dr. Birge: I have a paper from Arthur Sykes of Wisconsin, which, if there is no objection, I would like to present to the society.

Dr. Birge then read a paper by Mr. Arthur Sykes on the subject, "Inbreeding Pond-reared Trout."

Secretary Peabody: That concludes the papers.

Dr. Birge: We are all greatly disappointed in not hearing Prof. Reighard's paper and the joint paper of Prof. Reighard and Prof. Ward. I suppose that the absence of the lantern makes it impossible to give them. Would it not be possible, however, for them to furnish for the transactions a general statement of the contents of the papers, so that we could get them in printed form.

Prof. Reighard: I think it would be possible.

The President: As a committee to prepare such biographical mention of the members who have died during the past year as may be deemed proper and in accordance with the usages of the society, I will appoint Dr. Bean, Dr. Birge and Mr. Willard to make report at the next meeting of the society.

Mr. Titcomb: May I enquire if the photographs furnished by Mr. Lydell will be published with his paper?

The Secretary: Yes, I intend to have them in. I have selected some.

The President: I would enquire if the lectures with lantern slides, "A Method of Measuring the Efficiency of Quantitative Plankton Nets," and "The Meaning of the Secondary Sexual Characters of Certain Fresh Water Fishes," could be given in the transactions without the slides.

Prof. Reighard: I do not think so. A good many of the illustrations are colored. I think the most that could be attempted would be an abstract of the articles, perhaps with some illustrations.

Mr. William H. Boardman, of Rhode Island: A good many of us who come here eager to learn are confronted with a rather perplexing situation. These topics are taken up, papers pre-

sented, long and exhaustive discussions had—but no conclusions reached. Now, how are we to decide who is right? I think that by some means a definite decision where possible should be made, settling once for all points which can be settled by us, so that it will not be necessary to take them up again, and so that we may know something of what we have accomplished.

The President: You will have to do as an old German justice of the peace used to do; he always said, "The last fellow got the best speech and I gives him the case."

Mr. Peabody: I move that the society tender a resolution of thanks to the United States Fish Commission for its kindness in putting the steam launch Shearwater at our disposal, and also for the great interest that the commission has shown in being represented here in such large numbers, in furnishing so much material for our discussions, and affording such great help to us in forwarding the work of the society.

Motion seconded and unanimously carried.

Mr. Bowers: I desire to offer a resolution heartily thanking the officers of this association for the conscientious and able manner in which they have performed their several duties, and to congratulate them upon the successful work of this society during the past year.

Motion seconded and unanimously carried.

The President: Before we close I wish to thank the society for the meeting, which to me has been one of great interest and satisfaction. The duties of the presiding officer have been simplified and made very easy by the excellent order maintained. I found it the least difficult convention to manage that I ever presided over, and our meeting has certainly been pleasant and, I hope, instructive to us all. I certainly have derived great benefit and pleasure from the papers and discussions we have had, and want to say to all of you who failed to meet us at Wood's Hole when our last convention was held there, that you will lose a large fraction of the pleasures of life, if you fail to go there next year, for it is certainly worth a trip across the United States to see that country and the work that the United States Fish Commission is conducting there. It will enlarge our vision very much on the subject of fish culture, and its concomitant stud-

ies. Thanking you for your kindness and courtesy to me during my presidency, I now lay aside the mantle of office, proud and gratified that it falls upon such worthy shoulders as those of my honored successor. (Applause).

Mr. Bowers: Before we adjourn, I desire to present to the society Dr. Green, of Dayton, Ohio, representing the Ohio state commission. (Applause).

Dr. Green: The gentlemen in Ohio have been absent from your convention from choice, not necessity. I am glad to say to you that while you have honored our state with your presence, we are sorry not to have been with you more frequently, but we are with you in spirit. We are trying to do the best we can. We have the best game and fish laws in the world, especially in regard to Lake Erie. We have been handicapped very much with our laws there, but we are in a much better position now, and we are going at matters in the right spirit, and intend to enforce the laws. We will have a patrol boat from which we expect great results. I am glad to meet you all and hope to see you at some future time. (Applause).

President Bryant: The society hopes that the commission of the state of Ohio will be with us hereafter and co-operate with us in the good work we are carrying forward, and we wish all fish commissions godspeed. We have appointed a committee to endeavor to stimulate and promote among the various state commissions the best methods of interesting the public and getting a right public sentiment in respect to the protection and propagation of fish.

Mr. Dean: In regard to the meeting next year, I understand there is an invitation for the ladies to come to the clambake. Does that mean we are to bring the ladies next year?

Dr. Birge: Anybody that can get the price of a ticket had better bring them.

The President: There were several ladies at our convention last year and they enjoyed themselves very much, and everything was done to make it pleasant for them. There is a standing invitation to the ladies to come to our conventions.

The society then adjourned sine die.

Deceased Members since last meeting:

James Benkard.

Prof. B. Benecke.

Prof. A. J. Malmgren.

J. S. Van Cleef.

E. H. Friesmuth, Jr.

PART II.

PAPERS AND DISCUSSIONS

THE HABITS AND CULTURE OF THE BLACK BASS.

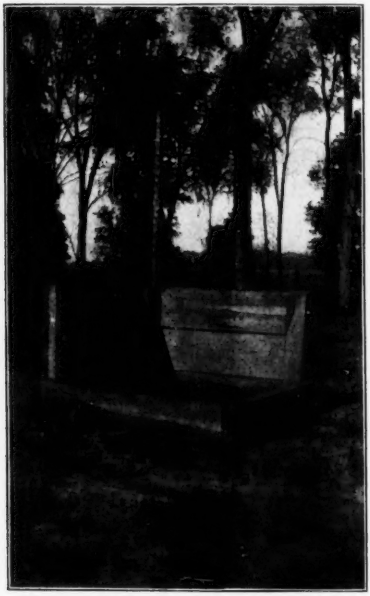
BY DWIGHT LYDELL.

In this paper I shall try to set down the experiences that I have had in the nine seasons, beginning with that of 1894, during which I have had charge of the Black Bass work of the Michigan Fish Commission. This work was begun at Cascade, Michigan, and after four seasons was transferred to Mill Creek, where it is now carried on. Since the methods of pond culture that have been finally adopted are based on a knowledge of the breeding habits of the fish under natural conditions, I shall begin by describing these habits. The account has reference to the Small Mouth Bass, unless the Large Mouth is specified.

In studying the habits of the bass it is necessary to distinguish the males from the females at a considerable distance. Ordinarily, it is not possible to distinguish them except by dissection, but just at the spawning time the female is distinguishable even at a distance of 10 or 20 feet on account of her distension with eggs. By this means I have been able to make out the part taken by each sex in nest building and the rearing of young. I have several times, while watching the fish, verified my determination of the sex by seining the fish in question and dissecting it, have invariably found that I had determined the sex correctly.

I do not hesitate to say that the nests of the black bass are built by the male fish working alone. The small mouth prefers a bottom of mixed sand and gravel, in which the stones range from the size of a pea to that of one's fist. As the spawning season approaches the male fish are seen moving about in water of 2 or three feet depth seeking a suitable nesting place. Each male tests the bottom in several places by rooting into it with his snout and fanning away the overlying mud or sand with his tail. If he does not find gravel after going down 3 or 4 inches, he seeks another place. Having found a suitable place he cleans the sand and mud from the gravel by sweeping it with his tail. He then turns over the stones with his snout and continues

sweeping until the gravel over a circular spot of some 2 feet in diameter is perfectly clean. The sand is swept toward the edge of the nest and there forms a rim a few inches high, leaving the center of the nest concave like a saucer. The nest is usually located near a log or large rock so as to be shielded from one side If the bank is sheer and the water deep enough, the nest may be



HATCHING BED.

built directly against the bank if possible. It is always so placed that the fish can reach deep water quickly at any time.

During nest building no females are in sight—but when the nest is done—and this takes from four to forty-eight hours—the male goes out into deep water and at once returns with a female. Then for a time—it may be for several hours—the male exerts himself to get the female into the nest and to bring her into that state of excitement in which she will lay her eggs. If she lies quiet he turns on his side and passes beneath her in such a way as to stroke her belly in passing. If she delays too long he urges

her ahead by biting her on the head or near the vent. If she attempts to escape he heads her off and turns her back toward the nest. If, after all, she will not stay in the nest, he drives her roughly away and brings another female.

Some fifteen to thirty minutes before the female is ready to enter the nest and spawn, her excitement is made evident by a change of color.

Ordinarily, she appears to be of a uniform dark olive or

SHOWING BEDS SCREENED.

brown above, changing to a light green below. The only markings readily seen are four stripes on each cheek. In reality however, the sides of the fish are mottled with still darker spots on the dark olive back-ground. The spots are arranged so as to form irregular, vertical bands like those on the perch—but these are not usually visible. Now as the excitement of the female increases the back-ground becomes paler and finally changes to a light green or yellowish hue so that the spots and bands stand out in strong relief. The whole surface of the fish becomes thus strongly mottled. This is a visible sign that the female will soon spawn. The male undergoes a similar but less pronounced change of color.

Soon after this the female enters the nest and the male continues to circle about her, glide beneath her and to bite her

gently on the head and sides. At times, he seizes her vent in his mouth and shakes it.

When this has continued for a time spawning takes place. The two fish turn so as to lie partly on their sides with their vents together and undergo a convulsive fluttering movement lasting three to five seconds. During this time the eggs and milt are extruded. The circling movements are then resumed, to be interrupted, after a few seconds, by spawning. This alternate circling and spawning continues for about ten minutes. The

POND AFTER BEDS HAVE BEEN SCREENED.

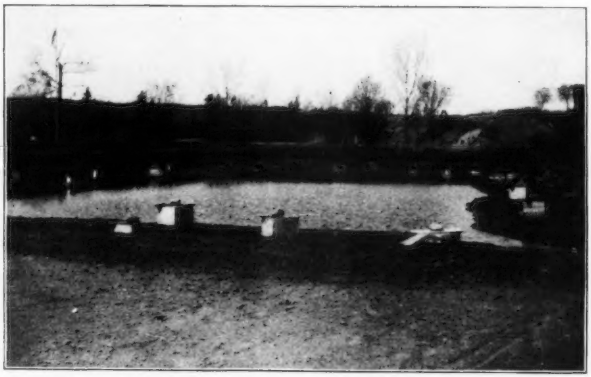
male then drives the female away, biting her and showing great ferocity. She does not return.

The male and the male only, now continues to guard the nest, fanning sediment from the eggs and repelling enemies. At 66 degrees Fahrenheit the eggs hatch in five days and the young fish swarm up from the bottom in twelve to thirteen days from time eggs are hatched.

Henshall in his "More About the Black Bass" published in 1898, quotes, with approval, Arnold's observations to the effect that the nests are built and then guarded by the female. Page in the "Manual of Fish Culture" published in 1897, by the United States Fish Commission, speaks of the nests as being built by the mated fish sometimes working together, and sometimes working separately. These seem to be the latest pub-

lished observations,—and are not at all in accord with my observations in Michigan.

After the young small mouth bass rise from the nest they soon scatter out over a space 4 or 5 rods across. They do not form a definite school, with all the fish moving together, but a very loose swarm in which the fish are moving independently, or in small groups. This habit makes it impossible to seine the young fry, as upon the approach of the seine, instead of keeping together, they at once scatter and escape the seine. The fry may be at the surface or on the bottom in weeds or clear water. They are attended by the male until they are an inch and a quarter



POND DRAWN DOWN WHILE SETTING BEDS.

long. The swarm then gradually disperses and the young fry, which were previously black, take on the color of the old fish.

The breeding habits of the Large Mouth Black Bass are similar to those of the small mouth, but differ in some respects which are of importance in pond culture.

1. The nests of the large mouth are not made on gravel, but by preference on the roots of water plants. These are cleaned of mud over a circular area and on them the eggs are laid. As the large mouth eggs are smaller and more adhesive than those of the small mouth, they are apt, when laid on gravel to become lodged between the stones and to stick together in masses. They

are then smothered. When laid on the fibrous roots of water plants this does not occur.

2. The young remain together in a compact school very much smaller than that of the small mouth and the fry usually move all in the same direction. This makes it easy to seine the large mouth fry when wanted.

CULTURE OF BLACK BASS.

1. *Ponds and Stock Fish.*

After some experimenting, all our ponds, both for stock fish and fry, are built on the model of a natural pond. There is a

POND DRAWN DOWN WHILE SETTING BEDS.

central deeper portion or kettle, about 6 feet deep, and around the shore a shallow area where the water is about 2 feet deep. The bottom is the natural sand, and water plants are allowed to grow up in the ponds. All ponds are supplied with brook water, and silt from this furnishes a rich soil for the aquatic plants. The water of these ponds contains Daphnia, Bosmina, Corixa and other small aquatic forms in great numbers. These furnish food for the bass fry. The ponds run in size from 120 feet by 190 feet to 100 feet by 100 feet.

At first we were unable to feed the stock fish on liver, but after a time we found that by cutting the liver into strips of about the size and shape of a large angle-worm and by throwing the strips into the water with the motion that one uses in skip-

ping stones, they wriggle like a worm in sinking and are then readily taken. The liver must be *fresh!* We found, however, if the fish are fed on liver alone they do not come out of winter quarters in good condition. Of eleven nests made by bass thus fed, only three produced fry. Although eggs were laid in all they seemed to lack vitality owing to the poor condition of the parent fish, and in eight of the nests the eggs died.

In order to bring the fish through the winter in good condition it is necessary to begin feeding minnows in September, and to continue this until the fish go into winter quarters.

HAULING DAPHNIA.

The bass eat minnows until they go into winter quarters, after which they take no food until spring. The minnows are left in the ponds over winter so that the bass, when they come out of winter quarters, find a plentiful supply, which lasts them until the spawning season. At this time the minnows are seined from the pond as their presence interferes with the spawning. Before this, however, some of the minnows have spawned and their fry later serve the young bass as food. When bass are fed in this way, they come out of winter quarters in fine condition and their eggs are found to be hardy.

2. *Artificial Fertilization.*

During the first two or three seasons of our work numerous attempts were made at *artificial fertilization,* but like all other

attempts of this sort, these proved to be failures. Only twice did I succeed in artificial fertilization. On one of these occasions the female was seined from the nest after she had begun to spawn. She could then be readily stripped. The male was cut open and the eggs were fertilized with the crushed testes. About 75 per cent of the eggs hatched on a wire tray, in running water, the eggs being fanned clean every day with a feather.

In the second case the fish were seined while spawning and it was found that in the case of one female, pressure on the abdomen caused a reddish papilla to protrude from the vent. This had the appearance of a membrane closing the vent. It was pinched off and the female then stripped readily and the eggs were fertilized and hatched.

3. *Pond Culture.*

Having abandoned artificial fertilization, our attention was next turned to *pond culture* and this we have carried on for about six years. Our earlier ponds were not of a sort to furnish natural spawning ground. For this reason we constructed along side each of the large ponds, six smaller ponds to be used as spawning ponds. Each of these was about 16 by 24 feet, 16 inches deep, with gravel bottom, and was connected to the central pond by a 4 foot channel.

The fish entered these and spawned. In one case we had eight nests in a single pond of this sort. Where as many nests as this were made, usually but one or two of them came to any good, the others being destroyed by the fighting of the male fish. Ordinarily, but one or two nests were built in each spawning pond. The male fish first to enter and begin the construction of a nest, generally regarded the whole pond as *his* property and held it against those that tried to enter after him. On one occasion the male thus holding the pond was attacked by ten or twelve other males at one time and after a long struggle was killed and his nest destroyed.

4. I now gave up the attempt to use small spawning ponds and had nearly all my ponds made of good size and with a central kettle and shallow shore area—as already described. The problem now was to prevent the fighting of the male fish and the consequent destruction of nests and eggs. I finally hit upon

what seemed to be the two chief causes of this fighting and found remedies for them. I had noticed that in the natural water the nests of the small mouth bass were frequently built against a stone or log so as to be shielded on one side. When they were so built the nests might be quite close together, as near as 4 feet, and the fish did not fight, because they did not see one another when on the nest. On the other hand, if a bass nest was built in a situation where it was not shielded the bass on that nest would prevent any other bass from building within 25 or 30 feet of him. It occurred to me then to try to construct artificial nests and shield them so that the fish on the nests could not see one another. In this way I hoped to be able to place the nests so near together so as to fully utilize my pond area and still not have them destroyed by fighting.

In the spring before the spawning season opened, I drew down the ponds so as to expose the shallow terrace along the shore. This terrace was then cleaned to a depth of about 2 inches of sediment and vegetation which had accumulated since the previous summer. Rectangular nest frames 2 feet square of inch board were now made. On two adjacent sides these frames were 4 inches high, while on the other sides they were 16 inches high. They were without bottoms, that is, were frames not boxes. The frames were then set on that part of the bottom where there would be about 2 feet of water when the pond was filled. Each was so set that the corner formed by the junction of its two lower sides pointed to the center of the pond while the opposite corner formed by the higher sides pointed toward shore. The frames were set directly on the bottom, not in excavations, and each was filled with gravel containing sand and suitable for nest building. A board was laid diagonally across the two higher sides and a heavy stone laid on this to keep the frame in place. The effect of the two higher sides of the frame is to form a shield on two sides of the nest; while the board across the top affords shade. The frames were set in two rows about the pond, parallel to the shore line.

The rows were about 6 feet apart and the nests in each row about 25 feet apart, alternating with those in the other row. There was thus about one nest to each 100 square feet of suitable bottom, or in each area 10 by 10 feet. When the bass were on

the nests no one was able to see any other and the fighting from this cause was practically eliminated. The number of rows of nests may be increased to three, or four, or more where the area of shallow water is wide enough.

The bass selected these nests in preference to any other spawning ground. They cleaned up the gravel and behaved in the nests in every particular as they would on natural spawning grounds. The first time we tried these shielded nests, not a single bass made a nest outside them, though there was plenty of good gravel bottom available for the purpose.

I come now to the second cause of fighting. The first season that we tried these nests (1900) we got from 475 stock fish 315,000 fry and 750 fingerlings. In the season of 1891 the output was very much less and there was considerable fighting among the fish. This remained unexplained until the ponds were drawn down after the spawning season, when it appeared that, although the fish had been sorted, the number of male fish was considerably in excess of the number of females. It was these excess males that had made trouble. Banding together they went about breaking up the nests of their more fortunate brothers. It is now our practice when we set the nests to seine out the stock fish and sort them putting about forty males to sixty females. Since each male is thus abundantly provided for, the second source of fighting is gotten rid of.

During the present season up to May 26th we had produced from 493 adult fish 430,000 fry—and we believe that we can do as well every year.

5. Up to the present year we have been troubled with two sources of *loss incident to our water supply.* The supply is a spring fed brook which runs over an open country before it reaches us. The water in this brook becomes quite warm on a hot, sunny day and cools off at night. The temperature thus falls at night sometimes as much as 13 degrees Fahrenheit and becomes as low as 46 degrees Fahrenheit. This is disastrous, since, when the temperature gets below 50 degrees Fahrenheit the adult fish desert the nests and the eggs or young fry are killed by the sediment. We have lost many fish in this way. We now get over the difficulty by watching the temperature of the

water and when it approaches 50 degrees Fahrenheit, we shut off the supply and keep it shut off until the water warms up. Since the ponds are well stocked with water plants the fish do not suffer from lack of oxygen when the water is shut off. Indeed, if the water did not leak out of the ponds I doubt if it would be necessary to introduce any running water into them during the breeding season.

The *second difficulty with our water supply* has been from sediment brought down by the brook after heavy rains which has sometimes accumulated over the nests so thick as to smother the eggs and drive away the parent fish. This difficulty also we now get over by shutting off the water supply whenever the water is much roiled.

The only difficulty with shutting off the supply is that the level of the water must be kept fairly constant. If it lowers more than about 6 inches, the fish leave their nests and the eggs die. For the purpose of maintaining a constant water level it would probably be best to have the ponds made with clay bottoms. The difficulties arising from roily water of variable temperature are, however, local and would probably not be usually encountered.

6. I have still to speak of the *handling of the fry after they rise from the nest and of rearing them to fingerlings.*

The fry of the small mouth have the habit of scatttering into a large swarm when they leave the nest, and it is consequently difficult to seine them when wanted. I have therefore adopted the practice of setting over each nest, just before the fry rise from the bottom, a cylindrical screen of cheese cloth supported on a frame of band iron. I first remove the wooden nest frame. The screen keeps the fry together. They thrive and grow within it and may be left there until one desires to ship them. The old fish stays outside and watches the screen. The fry feed on the crustacea inside the screen. When this supply is gone other crustacea may be taken from the pond with a tow net and placed inside the screen. We remove the fry from these screens directly to the shipping cans as wanted.

In order to raise fingerlings, I lower the water in one of the ponds, seine the old fish out of the kettle, and transfer them to

another pond. Then I refill the pond and put in my fry, now about one-half to three-quarters of an inch long. The water in the pond is thick with Daphnia and other crustacea and these do not go out when the water is drawn off. The fry feed on them and the supply is usually sufficient—but if it gives out, a fresh supply may be gathered from one of the other ponds and placed in the nursery pond. As the young bass grow they eat not only the Daphnia but young Corixa and doubtless other aquatic animals.

In 1901 fry one-half to three-quarters of an inch long were introduced into the nursery pond on July 12th, on August 5th they were seined out and shipped and were then 2 to 3 inches long. They had had none but the natural food! In three months these fish, under the same conditions are 4 to 6 inches long.

7. I have spoken so far of the small mouth and it remains to say *something of the large mouth,* with which my experience is more limited. It is less necessary to resort to pond culture with them since, owing to the habit of the fry of keeping in a close swarm, they may be readily seined from their natural waters shortly after they have left the nests.

In culturating them in ponds I use the shielded nests already described,—but make the bottom of some fibre, preferably Spanish moss bedded in cement, similar to those used by Stranahan described in the report of this Society for 1900. This imitates the natural nest bottom and gives better results in our locality than the gravel nest. I do not place screens about the nests, since the young fry are so small that it is difficult to hold them with a screen and since they may readily be taken with a seine when wanted. I allow the large mouth fry to leave the nests with the parent fish and seine them when wanted.

Finally, I will sum up what seem to me to be important points in pond culture of small mouth black bass. I assume the ponds to be constructed, as is usual, on the model of a natural pond with a central kettle and shallow shore region. They should be well grown up with water plants and should be supplied with lake or brook water.

1. Fish should be so fed (with minnows) as to be in good condition in the spring.

2. They should be sorted into the ponds in the spring in about the proportion of four males to six females.

3. Shielded nests should be used, arranged as already described—about one to each 100 square feet of shallow water.

4. The gravel used in the nests should be carefully selected; it should contain sand and plenty of small stones.

5. Water on the nesting grounds should be kept constantly at a level between 18 inches and 2 feet.

6. The temperature of the water should be kept constantly between 66 degrees and 75 degrees Fahrenheit (in our locality).

7. Roily water should be as far as possible kept out of the ponds during the spawning season.

8. Fish should not be disturbed until the eggs are hatched.

9. The small mouth nests should be screened just before the fry rise from the bottom.

10. The water should contain an abundance of natural food for the fry.

In closing I may say that I can see three ways in which my procedure might be improved.

1. I should provide special nursery ponds for rearing fingerlings.

2. I should try nest frames shielded on three sides instead of on two sides. I should make them with a bottom and when the fry rise from the nest I should close the fourth side of the nest frame by sliding a screen into it. In this way I should not have to remove the nest frame and put a screen over the nest, but would simply leave the frame in place and close the open side with a screen.

3. I should make the ponds with clay bottoms, so that if necessary the water supply could be entirely shut off during the breeding season.

FROM MILL CREEK HATCHERY:

Total output during year, ending at present time:

Small-mouthed bass fry	404,000
Big-mouthed bass fry	618,000
Fingerlings	36,050
Total	1,058,050

DISCUSSION OF MR. LYDELL'S PAPER.

Before his paper was read, Mr. Lydell said: On the subject of the black bass we have not committed ourselves to anything, because the more you say about this question, the less you have to take back later on.

At the conclusion of his paper, he said: And in closing, gentlemen, I wish to thank Professor Jacob E. Reighard for assisting me in preparing this paper.

Mr. Clark: This is a very valuable paper and Mr. Lydell has given the bass question as much study probably as any man in the United States. There is one problem of bass culture in which I am greatly interested and upon which I should like to hear from some of the bass men, for I am no bass man myself, although I have bred a few. We have those here who have given the subject a great deal of thought, and the one particular question to which I have reference is in regard to the planting, whether they think that bass fry deposited when two or three weeks old, are as valuable for our lakes and streams as those planted when three or four inches long, as fingerlings.

The President: I regard the paper as very interesting and valuable and one that is entitled to great attention, as Mr. Lydell may be regarded as one of the pioneers in this pond culture of bass.

Mr. Stranahan: In order to get this matter started a little bit, I would like to ask Mr. Lydell what he considers fry in his specimens.

Mr. Lydell: The small-mouth bass I consider fry the moment they commence to swim, and the moment they commence to swim up they commence to take food; and I consider them as fry, though before we get through shipping some of them are an inch long.

Mr. Stranahan: Show me what you commence on, if you please.

Mr. Clark: I would like to have Mr. Lydell tell us at what time they cease to be fry and become fingerlings, or perfect bass.

Mr. Lydell: The difference between fry and fingerlings is this: After they have changed their color, after they take on the color of the old fish, they are then one and a half to two

inches long, and then we commence to call them fingerlings. We have got to establish a point somewhere.

Mr. Clark: About how old are they?

Mr. Lydell: About 40 days old.

Mr. Clark: Then one that was 15 to 20 days old you would not call a fingerling?

A. No, sir.

Q. I would like to ask the question: Is not a large-mouth bass as perfect a fish at 15 to 20 days old in a temperature of water at 70 degrees, as one three months old?

A. It is at 20 days as perfect a bass as at three years.

Q. I would like to ask further, if you do not think that this fish planted in that water is equally as good with the exception of the protection you give to it, as one three to six months old?

A. Yes, sir.

Mr. Clark: The society will perhaps remember that I have always been a yearling man, but I am not so considering bass. Gentlemen, this is the point I am trying to get at. I do not like to see it undertaken to raise only about 50,000 fingerlings out of a half million fry, for I heard one superintendent say last night that it took half a million with him to raise 50,000 fingerlings. Now, if these fish are as well and perfect at the age of 20 days, and Mr. Lydell can plant 300,000 out of 500,000 at that time, and only 50,000 from three to six months old, then I think it is time that the matter was looked into.

Mr. Stranahan: I am of Mr. Clark's opinion, thoroughly. I have been advocating it for two years—made recommendations, and have written official reports urging the planting of these smaller bass. They are perfect bass, they are taking their food, they are old enough and smart enough to take care of themselves, and they are afraid of their enemies. Our former chief of fish culture was a great stickler for fingerling, and the larger the better, and we had it out in numerous discussions, and I am glad to say that our new chief of division seems to be in favor of planting smaller fish and more of them. I refer to the large-mouth bass—I have had little experience with the small-mouth variety. I had some experience north some years ago, and got good results from planting fry in streams in which the fish were

not indigenous. We got splendid results there from planting fry of the small-mouth bass.

Mr. Titcomb: I do want to say about this paper that I feel as if I was amply repaid for coming here just to hear it, if I did not hear anything else during the session; I think it is the best article on black bass I ever saw, by far, and I think it is going to help all the members of the United States Fish Commission to solve this bass problem. From what experience I have had since I came into my present position, I find that we have not solved this question. Mr. Leary has been planting fry at San Marcos with good success; this year a beginning was made at Mr. Stranahan's station of doing the same thing. While I have been a fingerling man to a certain extent, yet my views about the bass are that they are well able to take care of themselves when they are young, and it is much better to plant half a million or a million of these fry than it is to wait until you can plant only a hundred thousand, with the balance inside of the hundred thousand.

I wanted to ask one question about temperatures: What extremes of temperature will the adult fish stand in your waters?

Mr. Lydell: We have a temperature of 90 degrees there sometimes during the day. During the spawning season we must be very careful about the temperature. On a warm day, with lots of sun, the temperature may go up to 72 degrees, but when you get up the next morning and you have a temperature of 49 degrees or 50 degrees, and if any bass have spawned during the previous day you will find that the bass have deserted their bed and that the eggs are dead. But the temperature does not range much higher than 90 degrees for more than a few days, but during the summer months, after the spawning season, the water is allowed to run all the time, and it will cool down to 60 degrees every night during the summer, and the minute the sun strikes it in the morning it will commence to warm up, and as soon as the sun goes down the springs flow in, and of course it is cooled again, but our fish do not seem to take any harm from it at all.

Mr. Titcomb: One more question: In this water of yours is it equally favorable for both the large and small-mouth bass, or do you want different qualities of water for the two varieties?

Mr. Lydell: I have experimented some with the large-mouth bass this year and last year, and I find the water very favorable for them. Prof. Reighard saw us haul 48,000 large-mouth bass nearly an inch long at one dip of the seine in one of our ponds. We had only 30 specimens of the large-mouth bass at our hatchery this year, and from those I think there were obtained something over 100,000 fry, although only five productive beds were made. They were a scattering lot we picked up and did not know whether they were male or female. We put in the same pond quite a lot of small-mouth bass, and the two varieties did not quarrel or injure one another at all. The large-mouth bass were allowed to roam about the pond with 75 or 80 of the old small-mouth bass, and the small-mouth bass that spawned in there were in fifteen beds, and we screened those and took care of them in the usual way. There was plenty of daphne growing in the pond and lots of food for the large-mouth bass; and these bass that I have here were from that lot.

(Referring to specimens).

This bass thirty days old I took from the nest and put in a cage and kept there, and in that way I kept accurate account of them. (Referring to specimens).

Mr. Titcomb: You must have an unusual amount of aquatic life in the ponds.

Mr. Lydell: You can dip it up with a dipper anywhere around the ponds in the spring. We have to mow our ponds twice every year.

Mr. Stranahan: Is the water hard or soft?

Mr. Lydell: Some soft, and lots of spring water.

Mr. Stranahan: Is there lime in that?

Mr. Lydell: No, no lime.

Mr. Titcomb: Is there any other kind of plant life than you have named in the paper?

A. There is the cara and potamogeton, that is all.

Mr. Titcomb: You did not get all the large-mouth bass of which you mention, the total output, from these ponds—did you?

Mr. Lydell: No, sir, we had two auxiliary ponds. One is a small pond connected with the Soldiers' Home, from which we get lots of large-mouth bass, and another one we have rented, of

the extent of probably one and a half acres, from a farmer. That is where we get our large-mouth bass from now, principally. We have no room there to hatch them with the exception of what I have hatched there this year, about 100,000.

Mr. Titcomb: Did you ever see any large-mouth bass flirt with a small-mouth bass, as described in the paper?

Mr. Lydell: Not a particle: We had a pond where the large and small-mouth bass were mixed up purposely—the old ones—and the beds around the shore alternately were some of them Spanish moss beds and some gravel; and we had two pair of large-mouth bass that spawned on the gravel; although they did not amount to much. Their eggs settled down in between the stone and seemed to smother. On the other hand we had three pair of small-mouth bass that spawned on this fiber, and we got excellent results from them, but I think the reason they *did* spawn there was because they seemd to clean down and try to fan off that fibrous matter, and could not, but got to the cement and thought it was rock, and spawned there. But we had one trouble—we could not raise the nest away and screen it. If we made a screen big enough to get the whole nest, we could not catch the young bass.

Mr. Titcomb: As I understand it, it is necessary for the preservation of those eggs that the parent fish should fan them.

Mr. Lydell: Yes, sir, I think so.

The President: In our ponds at Minocqua we excavated them there and found the spring water coming in out of the gravel in considerable quantities. Do you think that was a detriment or advantage?

Mr. Lydell: It would not be a detriment unless there was too much of it. If you could get a temperature of 66 degrees and keep it there, I do not think the spring water would affect your bass in the least.

The President: What are the best dimensions for ponds for bass growing?

Mr. Lydell: If I were to rebuild our ponds over at Mill Creek, where I have these ponds, I would make them larger. Our last pond we built is the most successful.

The President: What is your judgment, Dr. Birge, of the dimensions of our ponds at Minocqua?

Dr. Birge: The lower pond must be about 300 feet long and the others 150 to 200 feet.

The President: And 60 or 80 feet wide?

Dr. Birge: Yes.

Mr. Brown: If there is much spring water coming into the bed the temperature would be too cold, would it not?

Mr. Lydell: Yes, if they could not keep the temperature up.

Dr. Birge: The spring water does not affect our temperature. It is a sort of a seepage spring, not a strong flowing spring, the temperature being somewhere in the region of 50 degrees Fahrenheit, and the lake water offsets what little spring water comes in. I should like to hear more about this matter of the size of the pond; and especially as to the margins.

Mr. Lydell: I have here a view of one of our ponds, 190 by 120 and six feet deep in the center. There is a margin of probably thirty feet clear around the pond and there is an island here; it has a shallow margin clear around the island to the shore, and there is a big pocket in the center of the pond 50 by 30, and six feet deep, and that is all the deep water we have in the pond, and that runs gradually to six feet. You will find the fish there invariably in the winter time, and all summer, unless they come out for minnows.

Dr. Birge: The broad margin of your pond is a decided advantage, of course. You need that for a spawning bed. If you made your pond large, would you make it irregular in outline so as to give you more margin?

Mr. Lydell: I would. Our ponds are nearly all irregular, and we get better results thereby.

Mr. Stranahan: What do you consider a proper number of small-mouth or big-mouth bass for an acre of water, everything being favorable.

Mr. Lydell: I would put into an acre, I should judge, about something like 200 females and 160 males, small-mouth bass.

Q. You would not think that excessive?

A. No.

Q. How about the big-mouth bass?

A. I am not posted on that.

Q. What is your opinion about it?

A. I would not put as many in in this little lake that we rented. By the way, I think renting that little lake was one of the greatest things that the fish commission ever allowed me to do. I rented it for $10 a year, if the output does not exceed 75,000, and if it does, I must pay the gentleman $15. Of course that is a lot of money.

Dr. Birge: That must affect your $75,000 considerably.

Mr. Lydell: I put the first season into that lake 48 or 50 fish raised at the hatchery, two years old, large-mouth bass. I think it was something like 60,000 or 70,000 fry I got out of there the first season, and last fall I procured forty-four or more large-mouth bass, adults, weighing anywhere from two to three pounds, and put them in there. I also put in a couple of wagonloads of minnows, probably 50,000 or 75,000. This year we got from that pond 262,000 fry, and 8,000 fingerling, and I was quite sorry that it went to that number, because the fish commission had to put up another $5. (Laughter). We have absolute control of this pond, and it is covered with chara nearly all over, with the exception of a little in the center; and on one end there are some pond lilies. It is nothing but mud; you cannot wade anywhere near it without rubber boots, and then you are liable to drop through the bogs, and there is only one place for them to spawn, and that is on the pond lily roots; and we had bass beds in that lake this year that were over ten feet across, and I went there as the young bass were coming up off the beds, and I presume two or three pair of bass must have spawned on that particular spot, for the young bass were coming up all over that bed, where it had been cleaned. You could see them if the sun happened to be just right. We let those alone in that pond—paid no attention to them—until they were about 15 days old, when they were all taken out of there, and nearly every fish that was shipped from that pond was one and a half inches to one and three-quarters long, and we took them with a seine.

Mr. Titcomb: What was the area of that pond?

A. I should judge it was about an acre and a half—it is a small pond.

The President: Let me ask you a question on another line: At our Minocqua hatchery we are right in a nest of bass lakes,

and every spring we can catch with our seines easily and without trouble, enough bass to put into our ponds. Now, would you prefer that method to keeping them in constant confinement? If you were situated so that you could get your brood fish by going right out into the wild lake and seining them and putting them into the ponds during the season of propagation, would you do that or would you keep them in stock all the time?

Mr. Lydell: If I could I would get my spawning fish in the fall of the year—what I need—I would hold all I could in my ponds and feed them, domesticate them as much as possible. I find that the wild fish when spawning season comes on are very shy; they will come up on the shore and make their nests, and if you happen to go along there, which we do not allow anyone to do during the spawning season—no visitor or employe is allowed to go around the ponds during the spawning season unless it is absolutely necessary—our superintendent cannot go down there unless it is absolutely necessary for him to go—they go just enough to feed the fish—I find that when these wild fish come out and spawn, they scoot off to deep water on the slightest provocation—they rush back and forth all the while. But our fish that we got the latter part of the year were domesticated so that you could get within ten or twelve feet of the nest and see the bass lying under the shadow of the board, guarding his bed. Of course if you went up close he would go away, but he would come right back, and I have oftentimes waded right up to the bed, put my hand on the stone, and the bass were lying there. Those were domesticated bass that we have had there several years.

Mr. Clark: Don't you think they are acquainted with Dwight Lydell and know him, so that they don't go away?

Mr. Lydell: I could not say as to that, but they say good morning to me every time I see them. (Laughter).

The President: Mr. Lydell has satisfied me that there is a good deal of human nature in bass, even to a degree of modesty in courtship. (Laughter).

Dr. Birge: I should like to ask a question along another line: You spoke in the suggestion at the end of your paper, of making the boxes protected on three sides, and then putting a screen in on the fourth side to avoid moving the nest frame

and putting a screen over the nest. If that were the case, should not the sides of the boxes be made high enough to stick up out of the water?

Mr. Lydell: Certainly—our boxes that we have now with protected sides are sixteen inches high; but I will raise the new boxes up above the two-foot level.

Dr. Birge: You will get circulation of water enough if you have a three-sided box coming up out of the water?

Mr. Lydell: Yes, sir, the three sides enclosed will have a strip of copper wire screen four inches wide around, near the surface of the water. With these boxes I am using now the difficulty is this, you have to wade out into your pond to take the boxes out of there, and you have to take them out. If you screened the box itself, you could not collect one fiftieth of the fry. Just as quick as you put your net in the water the fry will go to the frame immediately. But when you raise the frame out, it is filled with gravel, and the young fish are at the bottom. The sides of your gravel fall away and lots of your little fish fall outside, and some are buried in the gravel, and you roil up the whole pond. I have lost quite a few fish from that cause, although most of them are far enough along when you screen them so that they would not become injured. But with the other screen, all you have to do is to paddle around with a boat and drop the screen in at the side that is not protected.

Mr. Stranahan: How do you take the fry out of your box?

Mr. Lydell: In the same way as out of a screen. It answers the same purpose as a screen—it is a screen and box combined, and you can use the box for large-mouth or small-mouth bass as you see fit.

Mr. Stranahan: You would not make your strip of netting in the side more than four inches wide, and have it up near the top of the water?

Mr. Lydell: Yes.

Q. What mesh do you use?

A. Fine enough to hold young fry. We used the common wire that they buy for door screens, for our small-mouth bass, had it tarred two heavy coats, which lessens the size of the interstices somewhat. We do not screen any large-mouth bass.

Mr. Titcomb: When you take the fry out of the nest, you

raise the nest right up, do you? I refer to the boxes that have three sides of wood and one of screen.

Mr. Lydell: Take a dip net and dip them right out. We usually take a boat, or if some of the boys have boots on, they take a tub and dip the fry out and get them all that way.

Mr. Stranahan: Is there an opening in the top of the screen?

A. Yes.

Q. And by the screen you propose now the box is open on one side with top, and to remove it you take the stone on it off?

A. We have no stone on it—that is unnecessary.

Q. You would have that loaded down with your nest inside?

A. Yes. You might lay a board across the top for shade, if necessary.

Mr. Titcomb: Do you draw your pond down in removing your fry from your boxes?

A. Never.

Q. How much water is there in the boxes?

A. Twenty inches to two feet. Young small-mouth bass are all at the top on a sunny day, and you can get two-thirds of them the first dip; then you wait awhile and they will come up again, but it will be two or three days before you finally clean up the whole school.

Q. That is before they are trained to say good morning?

A. Yes, sir. (Laughter).

The President: How high is the sand at the bottom of your box above the bottom of the box?

A. Four inches. We fill it full and concave it a little in the center.

Q. Where you had a great deal of seepage from the bottom, would it not be better to raise it a little more?

A. There would be no harm in doing so. We used to use six and seven inches, but found four inches just as good in our locality, and we do not have so much to clean out of our ponds in the fall.

Mr. Stranahan: Suppose you are going to corral the big-mouth bass. Our big-mouth bass spawns every three months. So it would be important if we could clean up the whole school and have none left to eat up the subsequent brood. Now, if you

substitute your cement and Spanish moss for the gravel in the rig you describe, would it not work all right?

A. Yes, sir, if you want to ship the big-mouth bass when they first rise from the bed.

Dr. Birge: If you followed Mr. Lydell's last plan I do not see any difficulty if you wish to just take that nest after screening, right out.

Mr. Lydell: I have done that, but got no results. We had last year a lot of large-mouth bass spawn in this pond and I did not want them there, and I watched them till they were about ready to hatch, and I raised the nest up; I had added a bottom in it of this cement, and after I raised it above the water there was still two inches of water in the nest covering the eggs. I transferred those to a pond 16 x 24, and put in three or four quarts of daphne, but got no results. In the fall I think we had probably thirty or forty bass out of these three schools, where we ought to have had fifty thousand.

Q. If you had used the box and screen on the large-mouth bass when the bass had risen, you could lift the nest up and dump the bess out, couldn't you?

A. Yes.

Mr. Stranahan: I would be of the opinion that Mr. Lydell's plan of dipping them out would be better.

Mr. Lydell: If I did not want any in the pond I would dip out what I could and before taking the screen out of the nest I would take it out on the shore and rinse it out.

Q. Didn't you find that your Spanish moss rotted off toward the close of the season?

A. No, sir; I had Spanish moss that I had used two seasons, and it is in good condition for another year yet. I have used excelsior and used sea grass of some kind, and several other things. They spawned on it all, but it was only good for one season, and so I threw it away and used Spanish moss.

Mr. Stranahan: With us, late in the season it rots off. Though our water is very warm, standing 90 degrees, every day, and during three or four months running up to 100 degrees, and I think the high temperature has a tendency to rot it.

Mr. Lydell: Our beds are hardly ever in the pond more than thirty days.

Mr. Stranahan: Our beds would be occupied by succeeding bass.

Mr. Peabody: You speak of your pond that you rented, of an acre and a half, on which you raised large-mouth bass. Don't you mean to convey the idea that you have more success in that pond raising large-mouth bass than you do in your regular artificial ponds?

A. No,sir; from five beds I had something like 100,000, which is a great deal larger per cent than I had the other way.

Q. How many did you get from this one and a half acre pond?

A. Two hundred and sixty-two thousand.

Q. Were there any other fish in that pond?

A. Very few; that is the reason I rented the pond. There were a few sunfish, very small, some minnows, but hardly anything else; and there was plenty of vegetation there. In another instance we rented a lake probably four acres in extent, and put in 250 or 260 large-mouth bass, and got no results at all. There were lots of other fish, turtles, eels and everything of that kind, and our results from there were very unfavorable. In the Soldiers' Home pond two and three years ago we did very well; but this season the pond has become full of suckers, sunfish, blue gills and turtles, and our bass propagation there is commencing to dwindle. Unless we can draw that pond down and get rid of all those enemies, we will meet with failure there another year; but if I had the same pond where I could control it and draw it down as I wanted it, there would be no trouble to get a million bass from that one pond. The pond is about an acre and a half in extent.

Q. What do you consider the most injurious to the raising of bass—what enemies?

A. Small sunfish and minnows I have found do more to destroy the young bass than anything else in the world that we have ever found. I do not find that any beds are destroyed; I never found the beds destroyed, but in one of our ponds last year I carried on an experiment for my own benefit. I had, I think, fifteen beds of large mouth bass eggs. That pond was alive with minnows, and the vegetation grew up there early. About the time the young bass were coming off the nest, there

was plenty of vegetation in the pond and those minnows cleaned up the large-mouth bass so that we did not get twenty-five bass out of that pond. This year with one-third the amount of bass I got nearly 100,000, but there were no minnows in there.

Q. How old must the bass be before they can be destroyed by the minnows?

A. The moment they rise from the bed, that is, when the destruction comes; if they do not destroy them for a couple of weeks they are not going to do it.

Q. Then would it not be wise not to ship or plant the fry until they were of a proper age?

A. I never would plant the fry of the large-mouth bass, because what you call fry of the large-mouth bass are very small.

Mr. Stranahan: And there is not much loss up to the time when they become a perfect fish one and a quarter inches long?

A. No; we never ship large-mouth bass until they are nearly two weeks old.

Dr. Birge: Two weeks old means two weeks after they have begun to rise?

A. Yes.

Mr. Titcomb: If you had put the two weeks-old large-mouth bass into that pond where the minnows destroyed the product of your fifteen or twenty beds, would they then have held their own against the minnows?

A. They would. We tried that this year. In this pond I had large-mouth bass in, I had let a school come up; they were second breeding, and I had already introduced into that pond for the old fishes' benefit, several thousand minnows, and this brood came up just after we put those minnows in.

Q. That is conclusive evidence that it was safe enough to plant them at that age?

A. Yes. Most of our large-mouth bass this year we commenced planting at that age. We ship out an immense amount of what we call baby fingerlings.

Mr. Titcomb: These fish two weeks old that escape the minnows, do it by being too quick for the minnows?

A. Yes; the minnows have hard work getting them. I have watched a school of bass of that size moving along the shore,

and have seen a sunfish five inches long go into that school with a vengeance and not touch one bass.

Mr. Clark: I would like to ask Mr. Lydell why he calls this a baby fingerling and this a fry?

(Mr. Clark refers to two specimens, the first specimen being small-mouth bass, twenty days old, and about one-half or three-quarters of an inch long; and the second specimen being small-mouth bass thirty-two days old, about one and a half inches long, both specimens being perfect fish).

Mr. Lydell admitted a few minutes ago that this was a perfect bass. (Indicating the smaller of the two specimens).

Mr. Lydell: It is a perfect bass.

Q. And at that age will do just as well to plant as when from three to six months old?

A. Just as well.

Q. Then why do you make the distinction—one is equally as good to plant as the other?

A. Yes, sir, the only reason that we do not plant them all at that age is because we do not get time to do it. We commence planting and plant right along as fast as we can.

Q. You call that a fry? (Referring to first specimen).

A. We do in our shipping.

Q. And call this a fingerling? (Referring to second specimen).

A. Yes.

Q. Now, from the remarks made heretofore, it is as well to plant that, because that is a fish, not a fry? (Referring to first specimen).

A. Certainly.

Dr. Birge: You ought to draw the line when they commence to say good morning. (Laughter)

Dr. Bean: I think it is a proper distinction to call it a fry up to the time when it has absorbed its yolk-sac, and then call it a fingerling. A fry, as I understand it, is a fish which has not yet absorbed its yolk-sac.

The President: Mr. Lydell suggests that the best method is to capture your stock fish in the fall and keep them in confinement during the winter in order to be domesticated. What is the best means of subsistence for fish during the winter?

Mr. Lydell: Our small-mouth bass I cannot see take a thing during the winter; they lie perfectly dormant, going into winter quarters as the pond commences to freeze up. We commence feeding the liver just after the spawning, and continue that until along in September, and then they will be fed minnows until they go into winter quarters. When our fish went into winter quarters last year you could see minnows in abundance, and they had all they wanted; and this spring when we drew the ponds out we had to seine out thousands of them and put them away until the spawning season was over.

Mr. Peabody: I would like to ask a question on this subject: As I understand, trout fry, that has come down to a commercial basis, and they are raised commercially and sold—have you any idea how much it would cost commercially to raise bass fry?

Mr. Lydell: I don't know as I could state, except in one instance, because it cost the commission fifteen great big bucks to get 262,000 of them. (Laughter) If you have a pond that is successful the cost is very small, because there is nothing to be done to your ponds in the winter, only to keep the water running.

Mr. Henry T. Root, of Providence, R. I.: It is a fact that in the eastern ponds small-mouth bass are not dormant during the winter. Under natural conditions in a pond of 2,000 acres they are not at all times dormant during the winter. We frequently catch one or two or three in a day's fishing for pickerel. On one occasion a friend of mine caught over sixty through the ice, and that shows that they do not at all times lie dormant throughout the winter—that is, that they do feed, with us.

Mr. Lydell: I never had such experience.

Mr. Titcomb: Did you see the fish?

Mr. Root: No, but I know they were caught—no question about that.

Mr. Lydell: Some men were hauled up before the court a while ago for catching black bass, by the game warden. I was out there; Mr. Palmer was there also. The trial was had and they claimed that those were small-mouth bass caught in the winter, and the man got a new trial, and I came down and found they were nothing but the large-mouth bass. I have never

been able to catch small-mouth bass through the ice in winter, although I have heard of them being so caught. Some were said to have been caught through the ice at Kalamazoo, but the fish proved to be the large-mouth bass.

Dr. Bean: I can add something on the subject of black bass, because I have had them under observation in aquaria for some years at a time, and what I saw there partly corroborates Mr. Lydell's studies and partly differs from them. But we must bear in mind the fact that an aquarium is a different body of water from a pond, because the temperature is more or less under the control of the people in charge. I have seen the bass of both species take live minnows in the winter, but not often. Of course it is quite an advantage to have a fish before your eyes and to see what he does. We noted in the New York aquarium that the bass for the most part were dormant, but occasionally, whether it was because there was a little accession of temperature or not I do not know, they would rush at a live minnow and take it in just as lively a manner as at any other time during the year.

Mr. Palmer: At Jackson, Michigan, last winter, I know of twelve or fourteen arrests made for catching bass through the ice. I saw the bass and got them—and know it was done.

Mr. Lydell: Were they large or small-mouth bass?

Mr. Palmer: They were considered small-mouth, but since the trial at Three Rivers I am frank to say that I would not like to stake my reputation on it.

FOOD AND GAME FISHES OF THE ROCKY MOUNTAIN REGION.

BY DR. JAMES A. HENSHALL.

In the Rocky Mountain region there are three distinct groups of trout belonging to the *Salmo* genus: the red-throat or cut-throat, or as it is known by the United States Fish Commission, the "black-spotted frout;" the rainbow trout and the steel-head trout. They are all black-spotted. In widely separated sections of country they may be readily distinguished by certain characteristics, but in localities where they co-exist, naturally, it is sometimes difficult to distinguish one group from the others; indeed, at one time the rainbow and steel-head were pronounced by competent authorities to be the same fish, the steel-head being supposed to be the sea-run form of the species. At the present time they are held to be distinct.

The Dolly Varden, or bull trout, belongs to the genus *Salvelinus,* and is related to the brook trout of eastern waters, having also red spots. While the red-throat trout inhabits both slopes of the Rockies, the others named were originally confined to the Pacific slope.

The great lake, or Mackinaw trout, and the grayling are native to Montana. The former is found only, so far as I know, in Elk Lake at the head of the Jefferson river, while the grayling exists, naturally, only in the tributaries of the Missouri river above the Great Falls. It is worthy of remark that these two species are found nowhere else west of Lake Michigan, except in the Arctic region. It is fair to imagine that they were carried there on an ice floe during the glacial period, and it is not unlikely that both species were carried to Michigan waters by the same means, and that the Arctic grayling is the original species.

The small Rocky Mountain whitefish *(Coregonus Williamsoni),* is abundant. It is a good game and food fish, taking the artificial fly as readily as the trouts, but is popularly not so highly esteemed. It grows to about the same size as the red-

throat trout, and is, in my opinion, fully its equal for the creel or the table.

THE RED-THROAT TROUT. *(Salmo clarkii).*

The red-throat trout is the most widely distributed of all the Rocky Mountain trouts. It inhabits, naturally, both slopes of the Great Continental Divide, and as might be supposed from this extensive range it varies in external appearance more than any of the trout species. There are a dozen or more well-defined sub-species or geographical varieties, but all have the characteristic red splashes on the membrane of the throat. By means of this "trade-mark" it may be readily distinguished from the rainbow or steel-head or other trout. But while it varies considerably in contour, coloration and markings, in different localities, it is identical in structure wherever found. It was originally introduced to eastern waters as the California trout or Rocky Mountain trout, and at the present time is known as the "black-spotted" trout. The latter name is extremely unfortunate, as the rainbow and steel-head are also "black-spotted." The name red-throat trout is distinctive, and is preferable to the rather repulsive name of "cut-throat" trout by which it is also known.

The red-throat trout is commonly called the "brook trout," or "speckled Mountain trout," in the mountain region, which is also an unfortunate designation, as the eastern brook trout is now being introduced in the same waters. When it grows to a large size it is sometimes called "salmon trout," as in Yellowstone and other lakes, but the only salmon trout is the steel-head. The red-throat trout rises more freely to the fly than the eastern brook trout, though in gameness and flavor it is hardly its equal. Its habits are also somewhat different. It usually lies in pools and holes like the salmon, and does not frequent the riffles so much as the eastern trout. In size it is somewhat larger than the eastern trout in streams of the same relative width and depth, and like the eastern brook trout grows larger in lakes.

I have taken them weighing from three to five pounds in Soda Butte Lake in the Yellowstone National Park, and in Yankee Jim Canyon on the Yellowstone river. The red-throat seldom breaks water when hooked, but puts up a vigorous fight beneath the surface. As the streams are usually swift and rocky

and fringed with willows and alders, the angler must be wide awake to land his fish and save his tackle. In Yellowstone Lake it is infested with the white pelican parasite, rendering many of them emaciated and lacking in game qualities; those in the river, however, are well-nourished and gamy.

THE STEEL-HEAD TROUT. *(Salmo Gairdneri).*

The steel-head, or salmon trout, is the trimmest and most graceful, and the gamiest of all the trout species, being more salmon-like in shape and appearance. Its spots are smaller than in the other black-spotted species. It has, usually, a pink flush along the lateral line, but not so pronounced as in the rainbow trout. Its color is of a lighter hue than the red-throat or rainbow, with steely reflections.

During the past five years the United States Fish Commission has introduced the steel-head in the waters of Montana, which seem to be very suitable for this fine fish. I have seen quite a number of three-year-old steel-heads taken on the fly that weighed from two to three pounds, and in some localities they have grown still larger in deeper waters, which proves that they have come to stay. Each spring we now take thousands of eggs from fish that run up our waste water ditch from the creek where we planted them five years ago.

The steel-head trout surpasses all other trout for gameness and excellence of flavor, and rises eagerly to the artificial fly. It breaks water repeatedly when hooked, like the black bass, and is very trying to light tackle.

THE RAINBOW TROUT. *(Salmo irideus).*

The rainbow trout was introduced by the United States Fish Commission in the Firehole, or perhaps the Gibbon river, in the Yellowstone Park, from whence it sometimes descends to the Madison river in Montana, and may in time reach the Gallatin and Jefferson rivers. They have since been planted in other waters in Idaho and Montana, where they have done well, some coming under my notice weighing two pounds at two years old. The rainbow is similar in appearance to the red-throat, though somewhat deeper, perhaps, and with a shorter head and smaller mouth. Its distinguishing feature, however, is the broad red

band along the lateral line, common to both male and female. It is a handsome fish with rather more gameness than the red-throat trout, but not so vigorous on the rod as the steel-head trout of the same size. It grows to a larger size than the red-throat, but not so large as the steel-head.

THE GRAYLING. *(Thymallus montanus).*

Her Ladyship, the grayling, is as trim and graceful and withal as beautiful as a damsel dressed for her first ball. Her lovely iridescent colors and tall gaily-decorated dorsal fin, which might be compared to a graceful waving plume, must be seen fresh from the water to be properly appreciated. The grayling is not only a clean and handsome fish, but is as game as a trout and much better for the table. The grayling was taken in the Jefferson river a century ago by Lewis and Clark, and though they gave a fair description of it in the history of their expedition it remained unidentified until it became my good fortune a few years ago to recognize it as the grayling from the description of Captain Lewis.

While the grayling is found in the three forks of the Missouri, the Jefferson, Madison and Gallatin rivers, and in some tributaries lower down the stream and above the Great Falls, its ideal home is in the upper reaches of the Madison and Jefferson. The upper canyon of the Madison and its basin west of the Yellowstone Park is especially adapted to the grayling. There the water is swift, but unbroken, the bottom being composed of dark obsidian sand. In this region grayling of two pounds are not uncommon. The United States Fish Commission has been very successful in propagating the grayling at the Bozeman, Montana, station, and numerous waters have been stocked with this desirable game and food fish. About two million fry have been planted each season for several years in the streams contiguous to the grayling auxiliary station at Red Rock Lake at the head of the Jefferson, with the result of swarms of one, two and three year old fish. Grayling are so plentiful there that the trap can be opened for only a short time when taking spawners, otherwise they would enter in such numbers as to threaten them with suffocation.

As several million eggs have been shipped to eastern stations

by the United States Fish Commission, it is to be hoped that this incomparable fish will find suitable habitations in eastern streams to delight the angler with its beauty and gameness. It rises to the fly eagerly and is as game as the trout.

DISCUSSION OF DR. HENSHALL'S PAPER.

Mr. Peabody: Dr. Henshall's paper that was read just before the noon adjournment has had no discussion at all, and there are two points I would like to have considered. Two fish are named there, the grayling and the steelhead trout that he speaks of most enthusiastically. He says that the steel head trout is the gamiest and best of the trout species of which he knows, and especially in the Rocky Mountains, and he also refers to the productivity of the grayling, and says that they are plentiful and fill the streams out there. I would like to ask some of these Michigan men who know about the grayling, if they have stopped raising grayling, and also what the experience of any other fish culturist is regarding the steelhead trout. It seems to me if they are all that the doctor claims there, and are so easily reared and got from the hatchery in Montana, that they ought to be distributed and ought to be put into Michigan and Wisconsin waters especially. The commission gave us a quantity of eggs which we hatched and put in the northern waters of Wisconsin very successfully.

Mr. Clark: I can state that the United States Fish Commission is distributing the Montana grayling in Michigan although we don't know as yet what the result is, for I do not think that any have been taken, and unless a scientific examination is made it would be difficult to tell whether they are Montana or Michigan grayling. We are planting them so far only in the principal streams that formerly contained grayling, such as the AuSable River and Pere Marquette or branches, and unless otherwise ordered by the Commission I shall continue to do so until we see some results from those streams. They are a fine fish, and we have successfully raised them at Northville. There were on exhibition at Buffalo last season some two year old Montana grayling that had been reared at Northville, and I think every one who saw them will say that they were very nice fish, and from my observation of them at that age I do not see any

difference between them and the Michigan grayling. At earlier stages in their life, the first ones that we hatched, I doubted very much if they were grayling, although I do not know whether I corresponded with Washington in regard to the matter or not, but I think I spoke to Mr. Ravenel on the subject, saying that I thought the doctor had crossed them with trout, they were so spotted. Michigan grayling have no trout markings, but the Montana grayling have, and you can see them in Northville at the present time.

In regard to the steelhead trout, I will answer, so far as Michigan is concerned, that we have been planting them there for quite a while, and all those that have been caught are very large fish. One was sent to the Washington office this last winter which I think weighed seven pounds. There is one being mounted in Detroit that was caught near Traverse City that weighed twelve pounds, eight ounces; and there have been a number of other cases of this kind. The one that was forwarded to Washington I saw upon arrival. They seem to be caught in the great lake waters, or near-by, and my impression is that they are going to use Lakes Michigan, Huron and Superior, the same as they use the sea in their native country.

We have had remarkable success this year in the impregnation of the eggs, that is, getting a good quality, and I think that something like 90 per cent of good eggs were obtained from the fish, which we do not have from the rainbow trout.

Mr. Titcomb: You mean the domesticated fish?

A. Yes, sir.

Dr. Bean: I would like to say a word on Dr. Henshall's paper. The Montana grayling is not the same species as the Michigan grayling. It follows the usual rule among the graylings in that the very young have parr-marks. I do not know about the Michigan graylings. Mr. Clark has been in a much better position to learn than I, but speaking now as an ichthyologist and from book knowledge chiefly, I say that the young grayling ought to have parrmarks; the Montana grayling has them, the European species has them; the Montana grayling has a very much smaller fin than the Michigan grayling; its dorsal fin is shorter and lower; its head is smaller, and in other ways it is very easily distinguished from the Michigan grayling, so that

there will be no serious difficulty in future years if the fish establishes itself in Michigan, as I hope it will, in its being identified without any difficulty, when compared with the native species.

As to the steelhead trout (for it is a trout rather than a salmon) it is a spring spawner, and care ought to be taken in the introduction of the fish. I need scarcely remind fish commissioners of that fact, but I think it is liable to be overlooked in some circumstances. It is a fish more adapted to large bodies of water than to smaller streams. If it can find its way to the great lakes or to the ocean it will grow very large—even to thirty pounds. You know a fish that will approximate thirty pounds or even fifteen pounds, is a pretty dangerous customer to have associated with brook trout and other small species, because it is a great feeder and feeds at the time the brook trout are spawning. I merely mention these facts, because I think they ought to be kept in mind in the distribution of the fish.

The President: In distribution you would distribute them in lakes rather than in streams?

Dr. Bean: Yes, sir. They run up in the streams to spawn, but prefer to live in the great bodies of water where there is plenty of food and where they can have sea room.

There was a dispute for many years about the relation of the steelhead trout to the rainbow trout, this dispute was upheld on one side by my friend Dr. Jordan and on the other side by myself and I could not quite understand why there seemed to be so much difficulty on the part of the Pacific coast ichthyologist in recognizing the difference between the steelhead and the rainbow trout. There was no trouble in my mind about it; but I learned, much to my astonishment, a few years later that they had never seen a steelhead; the fish they called the steelhead was simply the sea-run rainbow. When the steelhead at last was found it was described as a new fish.

Mr. Clark: I hate to come up against scientists like Dr. Bean on this question, for I am not able to get down to the 1-1,000 part of a pound, as the scientists are, on these things, but the Michigan grayling, as hatched by myself in 1876, and again in 1880 or 1881, certainly did not bear the parr-marks. There is another distinguishing feature or difference in the two graylings, which anybody that remembers the Michigan gray-

ling knows. The Montana grayling hatches out and lies on the bottom, while the Michigan grayling pops out of the shell and swims like a whitefish. That is a difference that anybody will recognize; while the parr-mark is not visible on the Michigan grayling at any time.

Dr. Bean: That simply illustrates what I had in mind. I have been studying the young grayling chiefly from the books, and Mr. Clark has had the better opportunity of studying it in the field. That is where I go when I can, but when I cannot I am limited to books. The books all say that the young grayling ought to have parr-marks; the books also say that a male whitefish in the breeding season ought to have tubercles on the scales, sometimes it has and sometimes it has not. As a matter of fact, we do not know nearly all that is to be known about fish—even the wisest of us. There is a great deal more to be learned and it is to be learned from the fish themselves and not from books.

Mr. Titcomb: I was going to bring up a point which the doctor has brought up about the steelhead trout, and I think it should be emphasized as much as possible, and that is, as to the danger of introducing them into waters where you have the common trout. I should be inclined to treat them as just about as dangerous as the black bass to introduce in trout water. They are all right for our larger lakes, but I should be cautious about putting them into a lake with land-locked salmon even, but in any of our larger lakes with the lake trout it would be all right.

Dr. Birge: What do you mean by larger?

Mr. Titcomb: Not the great lakes necessarily. We have, for instance, a lake in Vermont six miles long where we are introducing steelhead trout very successfully, but that has nothing in it now but lake trout and small fish food. In Maine the commission has discontinued the distribution of steelhead trout, because almost all their waters which have not speckled trout have the land-locked salmon, which is valuable, and we cannot afford to lose them by the introduction of a new variety; and Mr. Peabody in considering that fish, should consider seriously where he puts it in Wisconsin.

The President: Would it do to put them in the same lakes with the bass, pickerel and that class of fish, armored fish?

Mr. Titcomb: That is a difficult question to answer. The

land-locked salmon will do well in some lakes with bass and pickerel, but in other lakes it is impossible to have them obtain a permanent foothold. I think the steelhead trout would stand a better show with the pickerel and bass than the land-locked salmon, if they have a wide range and the waters are varied in their nature. Take, for instance, some lakes which are peculiarly shaped, irregularly shaped, with many islands, and you will find the pickerel have their own part of that lake that they will be in most of the time, and one end of the lake where they spawn, and if the small-mouth bass are in the lake you may find them in still another portion of the lake, and it is possible with some of those lakes of irregular shape to introduce either the land-locked salmon or the steelhead trout quite successfully, especially if you have good streams for them to spawn in.

The President: They will have a Latin quarter and a Polish ward, will they? (Laughter).

Mr. Clark: Do you think the steelhead more of a cannibal than the rainbow?

Mr. Titcomb: Yes, they are more predacious and more voracious, because of their size.

Dr. Bean: In the West it is a toss-up between the steelhead and rainbow trout as to destructiveness of eggs; but the Dolly Varden is the most destructive consumer of salmon eggs in the waters.

Mr. Clark: I would like to ask Mr. Seagle this question: Do you find that the rainbow trout destroy the young trout?

Mr. Seagle: I do not. I have not observed more than half a dozen cases of cannibalism in my ponds since I have been having rainbow trout, covering a period of twenty years.

Mr. Clark: Do you think they will eat fish if they can get other food?

Mr. Dean: Rainbow trout will eat each other if they can, and we have to sort them, but not as much as the speckled trout.

Mr. Seagle: We keep our trout well sorted as to sizes, and possibly that is the reason we have no cannibalism. We sort our fish at least twice a year as to sizes.

Mr. C. E. Brewster, Grand Rapids: I would like to ask Mr.

Clark if rainbow trout are dangerous to the brook trout in the brook trout streams?

Mr. Clark: That is just the point. I think Mr. Dean will remember when he was with me at Northville that we had more rainbow trout than we have now, and possibly he was there at the time the experiment was tried of putting some large rainbow trout in a tank with smaller trout, and some large brook trout later on with smaller trout. We performed such an experiment at Northville, and the large rainbow trout did not eat the smaller fish, after leaving them there four or five days or a week; but the brook trout cleaned out nearly all the smaller trout that were in the tank. I never in my life have seen a rainbow with another trout in its mouth, while, of course, we are seeing brook trout do that all the time. We take them by the tail and pull them out. Our commercial men have had the same experience.

Mr. Lane: Yes.

Mr. Clark: I have never seen the tail of a trout sticking out of a rainbow trout's mouth.

Dr. Birge: You will write him a certificate of good character?

Mr. Clark: I will so far as that is concerned. It does not seem to me that they are cannibalistic at all. But Mr. Dean says he has seen it right along.

Mr. Dean: My idea is that the water being warmer makes a difference. I know at Northville at one time we put 55,000 rainbow trout in not a very large pool, and after carrying them some time we counted out 53,000. That would show there was a very small loss, but if we leave much larger trout in the ponds with them they become cannibalistic.

Mr. Clark: I do not wish to carry the idea that they will not eat fish. Of course if you starve them to it they will do so.

Mr. Brewster: Not long ago a complaint was made that the rainbow trout in the little Manistee river (and this is the second season that they have begun taking fish from that river) were eating up the brook trout. The man who made the complaint was a gentleman who spends all his time on the river and runs a club house there. I replied to his letter expressing my doubt about the matter, and he stated that a gentleman connected with the Pere Marquette Railway Company had recently caught a

two and a half pound rainbow trout with a brook trout more than six inches long in his stomach. I still expressed a doubt about the matter, and when I was up there about three or four weeks ago he showed me a number of brook trout that were badly lacerated, which showed that they had been caught by some larger fish and had been chewed up in the efforts of the larger fish to turn their prey and take it down head first; and those fish I examined very carefully, and they certainly looked to me to have been exactly as he stated: caught by some larger fish.

Mr. Titcomb: I have heard it said that the rainbow trout was responsible for the disappearance of the grayling in the Au-Sable river.

Mr. Clark: That is not the case.

Mr. Titcomb: I do not know but what I was misled in answering a question about the comparative voraciousness of rainbow and steelhead trout. I am not prepaerd to say that a rainbow trout would do as much damage as a steelhead of the same size. I had one experience with the two fish together of the same size in an aquarium four feet by two by eighteen to twenty inches high. These fish would weigh about a pound apiece. We had three or four rainbows, three or four speckled trout and one steelhead. We had to remove all the fish except the steelhead to save their lives—the steelhead was chasing them all over the aquarium and tried to drive them out of the water: he gave them no rest no matter whether they were speckled trout or rainbows.

Mr. Clark: Right in the Detroit hatchery I have in the aquaria rainbow and steelhead trout; I have seen the steelheads fight almost continuously during the spawning season, but I never saw them take down in their throat or undertake to swallow their antagonists, but they will fight viciously during that period. Was not this at the spawning season?

Mr. Titcomb: No, it was not. We have the same trouble with the rainbow trout during the spawning season.

Mr. Clark: Yes, but I have never seen them undertake to eat other fish.

Mr. Brewster: I would like to furnish Mr. Clark a brook trout from the Little Manistee that shows the marks that I have

described, and would like to have him examine it and pass judgment on it.

Mr. Clark: I do not think I could tell the markings of a rainbow trout's teeth. It may have been captured by some larger fish and chewed up.

Mr. Brewster: They think it is the rainbow and I think it is, too.

Mr. Clark: Show me a rainbow trout with a brook trout in its mouth, and I will be convinced.

Mr. Brewster: I did not see that.

Dr. Bean: I have had some experience with rainbow trout both in ponds and in the aquarium; and it is very well known on Long Island that the rainbow trout is the most voracious fellow in the ponds. One bully, (and not necessarily the largest fish) will boss the whole pond or tank, and he will drive every fish away or kill them, frequently, unless they are taken away. We had that trouble in the New York aquarium. We put in some of the fine rainbows from the Long Island hatchery, obtained from the United States Commission, and they were all alike. They would fight outrageously outside of the spawning season—any time seemed to be scrapping time with them—and there was no way of keeping them alive except by taking out of the tank the fighters, and we would have to take out a new one about every day.

Mr. A. L. Coulter: I would like to ask Mr. Clark one question: I am not a fish culturist; I do not study half as closely the habits of fish as I do the habits of the violaters of the game laws of Michigan. But I find that conditions in certain portions of the country change very materially. I think Mr. Clark will agree with me that the AuSable River at one time was a grayling stream; later in its history it was a speckled trout stream; after the speckled trout was introduced the rainbow was introduced.

Mr. Clark: The rainbow trout were introduced first in the AuSable river.

Mr. Coulter: Then take the Boardman river: the facts are that wherever rainbow trout are put in different streams the speckled trout disappear and the rainbow trout predominate. You could not convince a native on those streams in a hundred years, or by all the books and technical knowledge on earth, that

the rainbow trout were not destroying the speckled trout in the Michigan waters.

The President: Was the grayling driven out by another planting?

Mr. Coulter: The theory of the average mortal along those streams, who has lived all his life there and watched the disappearance of the native graylings, is that the speckled trout have destroyed the grayling, and in turn the rainbow trout is destroying the speckled trout, and you cannot convince him of anything else. I think at one time the Boardman river had some grayling in it; it was at first a native grayling stream, and the grayling was afterward replaced with speckled trout, and today you will catch about half and half, but the speckled trout are disappearing every year.

The President: I have been told by your Michigan fishermen that the grayling was a fish you could fish out more easily than you could trout; that you could go to a pool and catch every one of them; that is, they did not appear to be affected and get shy as others do, by the disappearance of their mates, but you could take the last grayling out of the pool and he would bite as eagerly as though he had not lost any of his companions.

Mr. Clark: I think that is true.

Mr. G. W. M. Brown, of Michigan: I went into the wilderness of Michigan early in 1869 and 1870 on the Pere Marquette, Baldwin Creek and Percy rivers particularly. On the first day of May, 1892, myself and a friend caught 163 grayling in one pool in the Manistee river in eighteen mile bay. That is the last day that I ever had fine fishing for grayling. The policy of the Michigan Fish Commission for the last two years has been in planting rainbow trout to put them in the larger streams where the water gets too warm for brook trout—in the Pere Marquette and the AuSable, but we do not furnish any rainbow trout for the smaller brook trout streams. For ten years I have been engaged in raising brook trout on a private, protected stream, as fine a stream as I ever saw, and the rainbow trout do not run in that stream at all; but right at the mouth of the stream last June I caught four rainbow trout that weighed eight and one-half pounds, although not a rainbow trout has been caught in that stream in the last ten years weighing a quarter of a pound. It is

a comparatively small stream and cold all the time; they do not run out of the larger rivers into the smaller streams

Mr. Clark: I did not bring up this subject to defend the rainbow trout for a moment, because it is immaterial to me which fish we have. I like the brook trout personally just as well as I do the rainbow trout. The part I wished to bring out was this: I wanted to know positively whether rainbow trout fed upon other trout. Now, Mr. Brewster has spoken of the AuSable river. The records show that the rainbow trout were the first ever planted in this stream, and old Uncle Dan Fitz Hugh was the man who put them there; and everybody knows what he had to say about the grayling and what he knew about it. This latter fish was plentiful there before the brook trout came, but they never have been so numerous as the brook trout now are, and I do not believe they ever will be, right in the AuSable river. If anybody can demonstrate to me that the rainbow trout fishing is better between two or three miles above Steven's bridge and down below Wickley's bridge than it was ten years ago, I would like to know it. Mr. Dickerson doesn't find it so—as he told me. They do not get any large rainbow trout above Wakley's bridge, except in spawning season but catch them in deep water. I have seen the rainbow trout up that river in March when you wardens are not there, and have seen a five-pound rainbow trout five miles above Steven's bridge; those large fish have been caught clear to the up dam during the spawning period. When we were hauling seines and catching brook trout for propagating purposes, we captured nearly as many rainbow trout fry as we did brook trout fry; but the large fish drop down in the deeper water where you do not get any brook trout.

Mr. Brewster: I think in 1891 the first rainbow trout was taken on the Bourdman river by Winnie of Traverse City. The river at that time was pretty well stocked with native grayling, and there were some native brook trout in the stream. It had been stocked heavily with brook trout, and from that time until 1895 or 1896 the brook trout fishing was good. Now more than 50 per cent of the trout taken from that river are the rainbow trout and the brook trout are gone or are becoming scarce. There are no grayling there at this time. I do not agree with my friend

Coulter that the brook trout have destroyed them; I think other elements have conspired to destroy them.

Mr. Coulter: I did not say that at all.

Mr. Brewster: Take the Manistee river up above the log chutes, the scene of the operations of the lumbermen, and you still find grayling and sometimes pretty good fishing. I know of a party of three who caught over 100 grayling there last year. Last year at my request Mr. Clark delivered half a dozen grayling to a friend of mine in Potoskey. Those grayling have been kept and are there now. I think he lost one out of a half dozen; they are being kept in water pumped from the bay. They are doing splendidly and growing nicely, and I believe that water up there is good for the grayling.

THE ROLE OF THE LARGER AQUATIC PLANTS IN THE BIOLOGY OF FRESH WATER.

BY RAYMOND H. POND, PH. D.

The primary object of an investigation of the biology of our Great Lakes, is to ascertain the factors which determine the quantity of food fish produced. The problems at once involved in such an undertaking are numerous, but may be in a general way, assigned to three groups. In the first group we may include those arising from the various relations which the different animals sustain to each other, such as, food and feeder, enemy and friend, host and parasite, and the like, all of which are strictly animal problems to be solved by the Zoologist. In a second group, would occur such questions as are suggested by the relations existing between animals and plants, and to these, the botanists as well as the zoologists may properly give attention. In the third group, we could include inquiries concerning the relation of plants to the soil and water, and such as belong more especially to the plant physiologist. Such a grouping of the secondary problems is purely arbitrary, being given to indicate the scope of the investigation, and to lead up to the statement already emphasized by Reighard and Ward, that a knowledge of the sources of nutrition of our food fishes, involves by necessity, an exhaustive study of the cycle of matter in the lakes.

There are two ultimate sources of food for the fish, namely; soil and air. Neither the fish, nor the animals upon which they feed, can secure nourishment from these sources directly. Plants must intervene to organize the mineral salts and carbon dioxide into food for the animals. In the case of the plant plankton, we have a large amount of organic matter that may be considered as food available for animals, which themselves in turn are either directly or indirectly used as food by the fish. Thus there occurs in the lake, a manufacturing of mineral salts and carbon dioxide into plant plankton, and also, a manufacturing of plant plankton indirectly into fish. It is thus evident, that each season's catch of fish means a withdrawal of so much organic matter from

the lake, and the sources of renewal of this organic matter, are manifestly important. It has long been known that water plants contain several essential food elements in greater proportion than the water, and we may say that aquatic plants concentrate within themselves nitrogen, potash, phosphoric acid. In the case of the plankton these elements must come from the water and then the plants die and are returned to solution. However, with the larger attached plants, we have another possibility, that is, they may take their mineral food from the substratum, and if they do, we have in them, agents active in the transfer of mineral food from the soil to the water. On the other hand, if the attached plants do not absorb nourishment from the soil, they must take it from the water, and their influence in this case would be to withhold during all the growing season, matter that would otherwise be available to the plant plankton.

The statement is common in all our text books of botany, even those published during the present year, that aquatic plants derive their nourishment from the water and not from the soil, that the roots are not organs of absorption as in land plants, but only holdfasts to anchor the plant. A review of the literature of this subject, shows that this statement is based upon argument and not experimental data. The anatomy of water plants has received quite a little attention in the past, and many authors have noted that the tissue systems for the conduction of water, which in land plants are so well developed, are in aquatic plants very rudimentary. Moreover, it has been observed that submerged aquatics have no evaporating surface and hence there is no necessity for an upward current in the plant. Again, the entire surface of submerged plants is permeable to water and the plant may easily secure its mineral food directly from the surrounding water. Such has been the majority opinion and argument up to the present time; but investigation now completed though as yet unpublished, proves beyond a doubt, I think, that most of our common aquatic plants are absolutely dependent upon being rooted in the soil for optimum growth, and few of them indeed can survive the growing season, if denied attachment to the soil.

To consider now some of the evidence for the latter opinion. Suppose we construct some large boxes and build a raft around

the top of them so that they will float about level with the surface of the lake or slightly submerged. In some of these boxes we will make a deposit of soil six inches or more deep. This soil is to be taken from the lake bottom in some locality where there is an abundant growth of plants. In this we will plant a certain number of individuals of uniform size, of some one species that have been carefully selected from specimens growing in the lake. In the other box we will attach a like number of such plants to wooden bars, and fasten these bars so that the plants in the two boxes are in the same depth of water. We thus have for comparison, two groups of plants, one of which is surrounded by natural conditions, and the other has natural conditions except that the soil is absent, and the plants can get only such nourishment as is provided by the water. After a period of four weeks very marked differences between the two groups of plants may be noted. The plants rooted in soil look as strong and healthy as those growing in the lake. The volume of vegetation produced by the former group was twice that produced by the latter group, while the suspended plants were stunted in growth and manifested the ordinary signs of unfavorable environment. If we now collect our two groups of plants, and after carefully washing, obtain the dry weight, it will be found to be a third more for the plants rooted in soil. It is thus evident, that soil is necessary for the best growth of these plants. If now we compare equal volumes of the fresh plants in our experiment, it will appear that the dry weight of the suspended plants is greater than that of those rooted in soil. This must mean that different physiological processes have been operating in the two groups. If a microscopic examination of the fresh plants be made, it will be found that the tissues of the plants rooted in soil contain relatively little starch, while those of the suspended plants are literally gorged with starch. Thus is explained our discovery concerning the dry weight of equal volumes. It is the abnormal increase in the amount of starch, that makes the suspended plants weigh more. If now we compare the two groups with regard to their chemical composition, we shall find that the plants which were denied the soil, contain a smaller proportion of nitrogen, of potash, and of phosphoric acid. To recall now the results of this line of investigation, we may say that when the plants are

not allowed to root in the soil, and are limited to the lake water for nourishment, an abnormal growth results, which is manifested by diminished volume of vegetation and total dry weight; also, by an excess of starch, and deficiency of nitrogen, potash and phosphoric acid.

Considering now the question, are the roots merely organs of attachment, or are they also for the purpose of absorption? It is not a difficult matter to separate the roots of a plant from the stem, so that solutions differing in chemical composition, may be offered to each at the same time. In this way lithium nitrate may be offered to the roots, so that the lithium, if found later by spectroscopic examination in the upper parts of the plant, may be positively known to have been absorbed by the roots and conducted upward into the stem. It is also possible to construct an apparatus by which the amount of water absorbed by a root in a given time can be measured. Both of these methods have been employed, and there can be no doubt but that the roots are organs of absorption. Moreover, the roots of most of our common aquatics develop structures, the presence of which is almost *prima facie* evidence that the organs bearing them are for absorption. These structures are the so-called root hairs, and they occur on all of our terrestrial plants, with a few exceptions. Examination has now shown that they are common also on the roots of aquatic plants. These hairs are simply ordinary root cells which are protected from the outer cell layer of the root, for the purpose of securing the maximum absorbing surface with the least expenditure of tissue.

We may next enquire, what quality of soil is best suited to support a good plant growth? Last summer here at the Hatchery, three soils were tested. One was a loam from Squaw harbor like ordinary garden soil, another was sandy with plant remains scattered through it, and the third was clayey. The same species was grown at the same time in each soil under otherwise natural conditions. The poorest growth occurred on the clay, the second best on the sandy soil, and the best on the loam. Thus is confirmed experimentally the observation made from the study of all the plant beds in the region of these islands, that other conditions being favorable, the most abundant growth of aquatic plants occurs on what would be called a good truck soil. Many

of the species will maintain a growth on any of these soils and continue to reproduce each season, but it is only on the good loamy soil that the dense aquatic meadows occur.

From a study of such meadows, some of the functions hitherto assigned to aquatic plants have been established, such as protection to animals seeking refuge, a base of attachment for the growth of Algae, and even as direct food for some animals. It is in protected caves little disturbed by wave action that such meadows occur, and the aeration of the water is an important duty of the plants here. During the daytime all green plants give off oxygen as a waste of product in the manufacture of starch, and an excellent idea of what this amounts to may be obtained by observing the almost constant stream of bubbles that rise from the plants on a bright day. But perhaps the most important part played by the larger aquatic plants is the one only recently established, that of contributing to the plankton food supply. One author has recently stated that there is a direct relation between the quantity of plankton and the proportion of nitrates in the water. During each season by the changing winds and currents a large amount of plant debris is carried out into the lake from the aquatic meadows, where during the period of its slow oxidation, it is available as food for the animal plankton and when oxidized, the mineral salts taken from the soil are contributed to the water to be used by the plant plankton in organizing more animal food. It is thus apparent that in the economy of nature, water plants have the same part to play with respect to organisms of a higher order, as the terrestrial plants; that is, they are the organizers of inorganic matter for the benefit of the higher organisms dependent upon their activity.

It is quite probable that the waters poor in plankton will be found to have a small growth of the attached aquatics. Certain it is, at least, that in any explanation to account for a scarcity of plankton in a given water, the relative abundance of the aquatic plants would necessarily be considered.

Some species are much more dependent upon the soil than others. Chara and Myriophyllum are not as dependent as Vallisneria and Potamogeton perfoliatus. The two latter plants would be excellent to plant in fish ponds, because they are so

dependent upon the soil and because they develop a large volume of vegetation during the growing season.

To recapitulate, we have first the facts hitherto known, that the larger aquatics are important as furnishers of shelter, as aerating agents, as a base of attachment for the growth of Algae and as direct food for some animals. Second, the fact first established in this paper, that these plants are important agents, through which the soil is made to contribute a goodly share to the food supply of the lake.

DISCUSSION OF DR. POND'S PAPER.

Dr. Birge: Was the experiment tried of raising these plants in boxes with earth and water, but with the roots removed? In the experiment described there was only one arrangement given —plants with roots and earth and plants without roots,—and with the ordinary lake water, of course. If 6 inches of earth had been placed in this box, it seems to me that a good deal of mineral salt might leach out of the earth, which the plants might have absorbed through the leaves; and I would ask, was that experiment tried, to see the difference.

Prof. Ward: I was only an observer of the experiment, but it is evident that in one respect, at least, the statement of the author has not been clearly understood. The roots were not removed from the plants, but the latter were very carefully selected, so that there should be no chance of any kind of bruising or breaking of the tissue to afford the slightest ground for supposing they were not in perfect physiological condition. The experiments were also tried in water so comparatively shallow that while there might have been a difference under the conditions which Dr. Birge mentions, I should rather imagine that there would not be. So far as I know, the exact experiment which he indicates of placing earth in the box but not in contact with the roots of the plant, was not tried. It, however, may have been, for Dr. Pond experimented very extensively and there were many experiments made of which he gave no definite report.

Mr. J. J. Stranahan, of Georgia: If the plant myriophyllum were used in a pond with poor soil and pure soft water, what would the result be?

Prof. Ward: I wish Dr. Pond were here. He experimented

three or four years on this matter and he has really found some things of very great value, and I deeply regret that he cannot be here to answer such questions himself.

Dr. Birge: Have you tried it yourself?

Mr. Stranahan: Yes, but our myriophyllum does not thrive. Our soil and water is not conducive to any kind of vegetable growth.

Mr. F. N. Clark, Northville, Mich.: We frequently meet this same difficulty at our meetings, the author of the paper not being present and these questions coming up that no one can answer. I think it would be well if the Secretary would note those points and ask the author of this paper to present something on that line and perhaps others, as an addition to his paper by way of discussion.

Dr. Birge: Why not have him answer any of these questions and have them printed.

Mr. Clark: That would be well, but we always have papers where the authors are not present and most always questions come up that no one can answer.

The President: Dr. Pond might add his answers to these questions as a part of the discussion. I believe that is practicable.

Mr. Titcomb: I suggest that Mr. Stranahan relate the results of his experiments under his peculiar conditions.

Mr. Stranahan: We have made a good many experiments; we have tried all sorts of fertilizers, we have tried a compost made with cotton seed meal and with barnyard manure, and we have succeeded in making our myriophyllum and other plants grow well the first year, but they almost always die out and become absent the second year.

Dr. Birge: Even if you continue the manuring?

Mr. Stranahan: We have not continued it, because it is impossible to do it in a pond full of fish. We have also had considerable correspondence with rice planters along the coast, and find that they have never found a fertilizer which is practicable for rice which is to be flooded, which is discouraging, because vegetation is of very great importance as shown by the success had by Leary at San Marcos. But there the soil was very rich and black; the myriophyllum growing from the bottom of the

pond to the top in one dense mass, in 6 or 7 feet of water; and there are more black bass produced there than at any other station of the United States Fish Commission—90,000 to 100,000 in one year.

Mr. Dwight Lydell, of Mill Creek, Mich.: I have found that the chara weed is better for pond fish than the potamogeton, as stated in the paper.

Mr. Clark: We have threshed this over each year and been in the same position ever since I have been a member of the association. At Wood's Hole we passed a resolution that all papers to be read by those in attendance should first be presented, that the papers by persons not present should be offered, and then be read as decided by the association. That resolution grew out of this very discussion that we are now in, and on your minutes of the proceedings at Wood's Hole you will find a resolution that no paper shall be read before this Society unless the author is there to read it, except by special resolution.

I wish to correct one statement of Mr. Stranahan's, where he spoke regarding the product of black bass. I do this out of respect for the superintendent of the bass hatchery at Mill Creek. The Mill Creek hatchery last year turned out over 1,000,000 bass.

Mr. Lydell: About 50,000 of those were fingerlings.

Mr. Titcomb: I hope no one here will refrain from asking any question that comes up in connection with this paper. I think if Mr. Pond is going to make an addendum to his paper for publication, he should have our views, and read our questions. It is a very important matter.

Mr. Clark: I have no objection. I simply state the resolution passed at Wood's Hole.

A SUCCESSFUL YEAR IN THE ARTIFICIAL PROPAGATION OF THE WHITEFISH.

BY FRANK N. CLARK.

As such unusual success has attended the efforts in the handling of whitefish during the past season, it is deemed that a few brief notes relative thereto would not be amiss.

The whitefish egg taking of the season just closed has been the most successful in Michigan, in the history of the United States Fish Commission. Not only has the quantity taken greatly exceeded that of any previous year, but also the quality has far surpassed that of any of the earlier efforts. This may be owing perhaps, in part, to the favorable weather conditions, improved facilities, and expert manipulation, but in the main it goes to show the wonderful results of the plants which have been made in the past in the waters of the Great Lakes.

In the collection and hatching of whitefish at the present time, two very important essentials are those of funds for carrying on the work, and then of obtaining the fish. With these two problems solved, the production of fry may be unlimited, and perhaps it might be well to state right here that of the above two mentioned factors, the former is a far more insurmountable barrier than the latter.

In the early days of the work, back in the seventies, the first successful take of whitefish eggs, with perhaps the exception of a few obtained on the Detroit River by Mr. Seth Green and my father, was made not three miles from where we are now holding this meeting. The quantity at that time, was limited to the amount obtained from the ripe fish which were found in the nets from day to day. This plan was continued for a number of years until it was discovered by experiment, that whitefish could be held in crates and pounds until ripe, thereby greatly increasing the production. This work of penning has been carried on quite extensively and with every success, on the Detroit River and at Monroe Piers, at the mouth of the Raisin River, Lake Erie.

It seems as though a no more forcible illustration of the gratifying results of the whitefish operations can be given than that of a comparison between the work of the past season and of 1896, but five years before. There was practically no difference in the methods employed, and the grounds operated were the same. In 1896 the total number of fish caught on the Detroit River was 11,263, while during the season recently completed 41,242 were taken, not far from four times the number obtained but five years previous under almost identical conditions.

Not only on the Detroit River, which is perhaps the best point on the Great Lakes for the collection of whitefish eggs, has the work been so highly successful, but at all other places where an attempt has been made the results have been the same. It is certain that the season of 1901 has been by far the best on the Great Lakes, and the records of both the United States and Canadian governments have never been equaled by the unprecedented take of upwards of 800,000,000 eggs. This large take resulted in the filling of every hatchery on the Lakes to its utmost capacity, and at one time it was thought necessary to plant a portion of the eggs on the spawning grounds. Later, however, this obstacle was overcome by holding part on trays for a short time. More auxiliary stations adjacent to the spawning grounds should be provided for the handling of the great surplus. This would do away largely with the necessity of transporting the fry for such long distances, which is not only very expensive, but at times rather detrimental to their condition. These auxiliary hatcheries will, no doubt, be provided for in the near future by the United States government.

The following account may perhaps give a fair idea of some of the details of the Detroit River work.

The collection of eggs was made from the field stations on Belle Isle and Grassy Island, the former being located in the Detriot River opposite the upper end of Detroit, and the latter about eight miles down the river below the city. The first fishing was done on the 16th of October and the work was continued until December 3rd. During this time, 2,875 hauls of the seine were made and 41,242 fish captured, an average of between fourteen and fifteen per haul, this latter being much better than usual.

Of these, 2,270 were undersized (weighing less than two pounds) and were immediately returned to the river, thus making 38,972 the number retained. They were held in crates and pounds, the former being made about twelve feet long, four feet wide, and five feet deep, of slats in order to allow free circulation of water, and the latter were of irregular size and shape, and built by driving boards into the bottom with a space between each one for free passage of water. The best day's fishing was on November 18th, when 2,568 fish were caught, and the best day's egg-taking was on November 29th, when 52,920,000 eggs were obtained. Of the fish held, 22,245 were males, and 16,727 females, and of the latter, 12,529 were stripped, the remainder being spent, plugged, or hard when operations ceased. The egg taking period extended from November 10th to December 11th, inclusive, during which time 366,040,000 eggs were forwarded to the Detroit Hatchery, thus making the average number per fish 29,215.

The number of eggs shipped to various points was 201,800,000, leaving 164,240,000 in the hatchery. As the total hatch was 135,000,000, it would appear that the percentage was a trifle above 82, but in reality it is about 85, when allowance is made for the fact that a part of the eggs shipped were eyed. The season was rather earlier than usual, as the fish were hatched between March 23rd and April 16th. The distribution continued from March 30th to April 17th, and was made by means of a tug and the regular transportation cars. The latter took 27,000,000 fry in five loads, three of 5,000,000 each and two of 6,000,000 each, the former to Charlevoix and the latter to Mackinac City. The balance were deposited in the Detroit River and Lake St. Clair.

Again let me emphatically state that there has just been completed the greatest known year's work in the artificial propagation of the whitefish.

DISCUSSION OF MR. CLARK'S PAPER.

Before reading his paper Mr. Clark said: I wish to state in connection with this short paper, that our good Secretary wrote me, I think, early in January, asking me to prepare a paper—I think he said something about whitefish or something in relation to whitefish—and I wrote him that I did not believe I would

have time to give him anything and did not know that I had anything new. That was the last I heard of it until the notices came out, and I saw he had me down for a paper. So I give you these few notes. It is not a paper, but a few notes on our work in connection more particularly with the whitefish. I do not want you to think you are going to get a paper.

Secretary Peabody: It seemed perfectly safe to put you down on the subject of whitefish, as being the greatest expert on that subject in the country.

Mr. Clark: I do not think so. There are many other whitefish experts in the country besides F. N. Clark.

The President: Was not the season an especially propitious one?

Mr. Clark: The water was very good, but the experience of the United States Fish Commission on the Detroit river for the three seasons we have been operating since the Michigan Fish Commission turned it over to us, is that there has not been so very much difference in that respect. I think that when the Michigan Fish Commission operated they did have three or four exceptionally severe seasons, when ice made in the river, so they could not fish. We had no trouble of that kind, and I think we are safe in anticipating a take of 300,000,000 or 400,000,000 eggs this coming season. It all depends on the temperature of the water both with the fish and eggs. I do not think it was an exceptional season. I think it was simply because Lake Erie has more fish today than it ever had before. I think Mr. Downing or Mr. Fox will bear me out in this statement judging by their work at Monroe.

The President: It is borne out by the commercial reports also, I think.

Mr. Clark: Yes, sir.

Mr. Gunckel: I never saw line fishing so good as it is out off Monroe this season. I caught with a fly one whitefish weighing eighteen and one-half pounds.

Mr. Stranahan: I would like to ask Mr. Clark, do you think there are more whitefish in the lake than there ever was, away back in the early days of fishing?

Mr. Clark: I do not mean to be understood as saying that. I mean that the increased catch of whitefish in Lake Erie is

wholly due to the propagation and planting of fish in the Detroit river and Lake Erie. I say it boldly because there is less protection to the whitefish in Lake Erie and the Detroit river. So, if it is not from our work, what is it from? The catch has increased each year gradually from 12,000 until now we are expecting to take 50,000 fish this fall on the Detroit river.

The President: That is the testimony of all of the fishermen along our shores, that the depletion caused by the fine nets, etc., has been arrested.

Mr. S. W. Downing, of Put-in-Bay: I would like to bear Mr. Clark out in his last assertion, that the increase is undoubtedly due to the propagation of the fish. We have steadily increased in the number of eggs taken. Two years ago 235,000,000 eggs were taken at Put-in-Bay. Next season 194,000,000, last season 335,000,000 eggs were taken. That in connection with Mr. Clark's station would make the total something over 700,000,000; and there is no question but what it is coming from the artificial hatching of the fish. We put out from this station alone this spring a little over 200,000,000 fry. Our total hatch was 81.8 per cent. Mr. Clark beat me about 3 per cent on his hatch.

Mr. Clark: Another fact bears out the results of our work. They seldom used to catch any small fish—that is, what we call underweight fish, those under two pounds. A year ago last fall we caught a little over 6,000, and last season over 2,000. Now, ten or fifteen years previous to that, no mention was made of the small fish, there not being enough to attract attention.

Mr. Lydell: It has been about fourteen years since I commenced taking charge of some of the river work, and at that time we had between 250 and 300 jars in the Detroit hatchery, and ran seven fishing grounds to fill those jars with eggs; and now we have 1,035 jars and three fishing grounds are sufficient to fill them—and more too. Last year I think we also filled the Duluth house and the Soo house and all the houses of the United States Fish Commission, easily, with three grounds.

Dr. T. H. Bean: (Formerly of the United States Fish Commission, now of the World's Fair at St. Louis). It has seemed to me that there was a little skepticism about the remark by my friend Gunckel about whitefish being caught on a hook, and I

thought perhaps it would be interesting to state something that has occurred in my own experience in keeping whitefish in aquaria. There is a whitefish which you know has been called the Labrador whitefish, but which I cannot distinguish by any essential characters from the common whitefish of the great lakes. All the characteristics that have been assigned to them by ichthyological writers prove to be transitory or non-existent, and for that reason I still hold to the opinion expressed a few years ago, that the Labrador whitefish and the common whitefish are the same species.

Now, it has been supposed, I think very generally, that that form of whitefish with the small mouth and the lower jaw shorter than the upper will not take the hook and will not take live bait. In the aquarium of New York City in 1897 we had a lot of so-called Labrador whitefish from Canandaigua lake. They were fed upon small fresh water shrimp, which were shipped from Caledonia and other parts of the state. They fed very readily upon them, but after a time it was difficult to obtain that food, and then we began putting into the tanks small salt water minnows, or mummichogs (killifish), and in a very little while the Labrador whitefish were rising to them and taking them the same as the trout did, and they continued to feed on them for months at a time.

And another fact, in Canandaigua lake, fishermen catch those same whitefish on baited hooks.

I saw a little item in *Forest & Stream*, by a Canadian member of the Fishery Commission, to the effect that the new whitefish, which evidently is closely related to the common whitefish, and I think Dr. Smith has identified it as Richardson's whitefish, is known up there to take the hook, and is so caught. I say this in defense of my friend Commodore Gunckel, and as a matter of some interest, because I do not think it is generally known that the common whitefish will take the hook.

Mr. Clark: I believe that Dr. Gunckel thought I would not smile when he spoke of catching the eighteen pound whitefish with a fly. I want to say that whitefish weighing two and one-half or three pounds, which have been raised in our ponds, take flies from the top of the water.

The President: That is the natural fly that lights on the water?

Mr. Clark: Yes, sir.

Mr. Gunckel: In looking over my records I find I did not wear my glasses when I made my first statement. The fish that I actually caught at the mouth of the river Raisin was a common carp. (Laughter). But Judge Potter, for many years a fish commissioner of the state of Ohio, told me probably twenty times of the whitefish that he had caught off Nipegon—I have forgotten the bait that he used—and I know when I go to Crystal Lake in the northern part of Michigan, of some Indians who come from Frankfort to sell whitefish (and I believe there are more whitefish to the square foot in that lake than in any lake Mr. Clark has in Michigan), and they catch them with hook and line. They bring in fifteen or twenty whitefish nearly every summer that I go up there to fish. They must bite with hook and line. All the propagation that you talk about leans toward the commercial interests. About three-quarters of the gentlemen present represent the angling fraternity of which I am a proud member. I believe I belong to some fourteen different angling clubs and societies in the United States—always have and I am now growing old in the business and have the reputation of being the biggest liar in the United States, and so am entitled to recognition.

Mr. Titcomb: To substantiate Dr. Gunckel's remarks—

Mr. Gunckel: Don't get that "Doctor."

Mr. Titcomb: I want to say that in Lake Winnepiseogee the whitefish is commonly taken with hook and line; and in further substantiation of Dr. Gunckel's remark about this particular whitefish which weighed so much, he took me aside here today and told me about it, but explained that he not only had a baited hook, but had a bated breath. (Laughter).

Mr. W. A. Palmer, Buchanan, Mich.: I would like to ask Mr. Clark to what he attributes absence of whitefish about Michigan City, St. Joe and Grand Haven, where they used to be so plenty?

Mr. Clark: Fishermen. I think there have been without question millions upon millions of small fish caught in Lake Michigan and other lakes—not so many in Lake Erie, because

they cannot get them. In Lake Michigan however, there has been just as much fishing as in Lake Erie, while the former has not been anywhere near so heavily planted, therefore to furnish its quota many of the fish have been under weight. The fishermen being after every one they can get, regardless of its size, and consequently the fish are being greatly reduced in numbers in Lake Michigan. I think if we could plant fry in Lake Michigan as we are doing in Lake Erie and Detroit river, you would see in the course of five to fifteen years, a great increase in the Lake Michigan output. Lake Erie and the Detroit river have had at least one-half of all the fry that have been hatched on the great lakes.

Mr. Palmer: In other words, Lake Michigan and that vicinity have not had any fry there.

Mr. Clark: Oh, no, I do not say that. They have had quite a good plant every year. This year we put in Lake Michigan about 30,000,000, and I think very likely Wisconsin must have put in 20,000,000 or more.

The President: We did.

Mr. Clark: But 50,000,000 fry is not enough for Lake Michigan. We should have 500,000,000.

The President: I would like to ask, is the whitefish a migratory fish, or does he stay in the vicinity of his birth place, or where he is planted. Do they rove around and colonize other parts of the lake, or are they local?

Mr. Clark: I cannot answer that question. I have been connected with whitefish work for thirty years, and that is a question that I cannot answer you. Perhaps our scientific men can, but I cannot; however I can say that the whitefish are in the Detroit river in the fall and I know that they are not there in the spring, but whether they go a long distance or not I am unable to tell. We do not get, or we did not used to get, the same colored fish in Lake Huron that we do in Lake Erie and the Detroit river. I hardly think they ever go up through the St. Clair river into Lake Huron, but still I cannot answer those questions.

Mr. Palmer: A large quantity of whitefish were caught this season in the vicinity of Charlevoix, while at South Huron, formerly one of the best fishing grounds, there have not been any.

Mr. Clark: I can say in answer that for a term of years the United States Fish Commission have not planted any whitefish in Lake Michigan below Frankfort, and our reason for it is that we do not believe the whitefish spawn below that point. We do not know for certain, but are waiting for the Scientific Bureau to make investigation. The only way we have of knowing where whitefish spawn is by looking the fish over that are caught by the fishermen at such points, and I do not think there have ever been any eggs taken from south of a point near Frankfort across the lake. Years ago we used to send men to St. Joseph, Michigan City, and I think one year I had some men over on the other side near Waukegan; but we never were able to get any ripe fish there, and that is the only way we know as to whether or not they are spawning at that point. I think that after we have our scientists do some dredging and working on that line, they will be able to tell us. I believe I have stated that we do not know where the spawning grounds are. As long as we have taken eggs off Alpena, ever since 1880, we get ripe fish at certain points, but I am here to say that I do not know that that is the spawning ground, because there have never been any eggs taken up from the bottom.

Dr. Birge: That would indicate a very considerable distance of migration. Whitefish are caught all through the southern end of Lake Michigan and the schools must have migrated 80 or 100 miles there, if the fish did not spawn south of Frankfort.

Mr. Clark: I would not call 80 miles a great migration.

Dr. Birge: I would not think so either.

Mr. Clark: When we have this biological station some of these questions will be settled, and I do not expect to see this problem decided until a thorough investigation on that line is made and this is what the practical fish culturists on our great lakes are waiting for—something along that line—and our scientists must start it.

Prof. Reighard: I may, perhaps, throw a little light on the question of the existence of local races of whitefish: Last summer the United States Fish Commission sent a man to Lake Erie to study the local races of whitefish, and he worked at several places on Lake Erie, by the statistical method, making very accurate measurements and determinations of color of whitefish

in different regions, but was unable to find any local differences. Now, in the case of some of the marine fishes, those local differences are very noticeable, and by making such studies it is possible to locate local races. The whitefish spawn in the western end of the lake in the fall, and that would obliterate local races by interbreeding.

On the other hand, this same man, Dr. Raymond Pearl, has gone this year to the northern end of Lake Michigan and is at Charlevoix now. He has been measuring the whitefish there and he finds very distinct evidences that they form a different race. This race is very markedly different in its measurements from that of Lake Erie. Of course that is nothing more than the fishermen have said for many years, that they could tell Lake Erie whitefish from Lake Michigan whitefish, but so far as scientific evidence goes it is all there is, I think.

The President: Is there not a whitefish called a bluefish?

Mr. Clark: Yes, sir, but that is not the fish under discussion.

I would like to ask Prof. Reighard whether his investigator at Charlevoix has examined a sufficient number of specimens to know whether he may not have had some fish that were planted there and had increased in size.

Prof. Reighard: That was one of the things had in mind in sending him up there, but as far as I can learn he has no evidence on that point. It ought to be possible to find by this method trace of Lake Erie whitefish planted up there, but he has not got them yet. That may come out when he reaches the final discussion of his results.

Mr. Clark: This could lead into a great many questions we would like to ask, but I do not know as we ought to take up the time.

The President: It is a very interesting topic to us who are situated on the great lakes.

THE BROOK TROUT DISEASE AND CEMENT PONDS.

BY M. C. MARSH.

At the preceding meeting of this society, in some remarks on the brook trout disease, you may remember that it was pronounced to be probably bacterial, but that this had not been definitely established by the usual process applicable in such cases. Since that time experiments on healthy trout at Northville have furnished substantial proof of its bacterial nature. It is not necessary to go into these in detail here save to say that they consisted of a series of inoculations into healthy trout of pure cultures of bacteria taken from the blood of diseased trout. Such inoculated trout developed the same symptoms and lesions as those which had contracted the disease in the natural way, and like them, they died. The experiments were controlled by duplicate lots of healthy trout which were kept in the same water and fed the same food as the others, and under identical conditions save that they were not inoculated with the cultures. There was no loss among these latter trout. The bacterial organism used in these inoculations is now regarded as the cause of the brook trout disease.

Cement ponds were proposed as a rational method of preventing this trouble with the brook trout. It was held that the germs of disease menaced the trout in small ponds from two sources,—the immediate surroundings of the pond, and the water supply. Just what the relative importance of these two sources was could not be stated with certainty at that time, but there were reasonable grounds for believing that the former—the linings of the ponds and the earth about them—was the greater of the two, and that if this danger were removed that the disease might be prevented. The cement ponds were directed against the one source of infection alone—the localized or secondary source—and could not protect against any infection which might flow down with the water supply. There seemed to be a reasonable chance that danger from the water supply was not great enough to cause the epidemic every year, largely because the fry in the troughs had

seldom had the disease. Accordingly, two of these ponds were built last fall at the Northville Station of the United States Fish Commission. They had a foundation of concrete and a superficial layer of cement on sides and bottom, so that they were solid throughout and impervious. Nothing could enter these ponds through the construction itself, but must come by way of the water supply or directly from above. They were stocked with brook trout without suspicion of disease, some from the Au Sable River, secured by permission of the Michigan Fish Commission, the rest from the trout farm of Mr. Hansen, at Osceola, Wis.

We have now had nearly a year's experience with these ponds. They have failed to prevent the disease. Most of the trout thrived in a promising way until January, when they commenced to die. The dead had the suspicious marks or lesions of the disease and from the blood pure cultures were obtained of the same organism that had previously been found in the diseased trout, before the cement ponds were built. It is the same disease recurring. The Au Sable trout began to die very soon after they were placed in the cement ponds. Now, a large per cent of the Au Sable fish had sustained injuries chiefly of one sort, a bruised snout from contact with the crates in which they were temporarily held. The injured snout is an open door for the entrance of micro-organisms into the blood. The protecting skin is broken, the tissue beneath is left raw and a bacterium drifting against this exposed surface finds an easy lodgment and nourishment of exactly the sort adapted to it. It immediately begins to multiply and is carried into the circulation and finally brings about the death of the trout. The rule may be laid down then that trout with the skin intact have the best chance of resisting the initial attack and that those with wounds of any kind can be placed in infected waters only with fatal results. The other trout were uninjured fish and they resisted the disease for some months or until the organisms had time to make their way through more minute wounds which doubtless all fish receive in the natural course of their existence, or by way of the intestinal tract having been taken in when feeding; or they may possibly have penetrated slowly the unbroken tissues.

The cement ponds are, then, if this one year's trial is a reliable index, as it probably is, a failure as far as their main pur-

pose is concerned, prevention of this disease. They demonstrate this fact very clearly—that they are insufficient to deal with it as exemplified at the Northville Station, and in so doing they make a valuable contribution to knowledge of this disease, and an important step is taken in attempts at prevention. For the idea of excluding infection by an impervious construction followed naturally from the nature of the disease and was one of the very few practicable means of dealing with the problem. The ponds accomplished this exclusion, for they have withstood the severity of winter and are practically intact. They have protected the trout from infection contained in the earth about the pond and this being insufficient the conclusion is forced that the water itself brings into the pond the bacteria of disease and that the springs that supply the station are their source. That these bacteria arise in the springs is a matter of very serious import. It throws the origin of disease back to a source over which we have no control. It is impossible to disinfect these springs. Disinfection can occur only in the superficial layer of the bottom while fresh infection is constantly arising from the depths. The water cannot be filtered to a germ free condition on the necessary scale for practical operations. The infection cannot be dug out. It is a natural attribute of the supply springs and I do not see any means of dealing with it which allows brook trout culture on the present intensive plan, i. e., many fish in a small space, and at stations with infected water.

This does not compel the abandonment of the brook trout at such stations, however; at least, not as yet. The next thing to be recommended is culture in comparatively large natural ponds. The chief advantage gained is the increase of space, diluting the infection and separating the fish. The more natural conditions, aside from space, doubtless have their influence also. There is some past experience favorable enough to justify such a pond. Mr. R. S. Johnson of the United States Fish Commission has checked the disease in this way at his station at Manchester, Iowa. It may be considered a sort of compromise with the disease because even if continuously successful, it cannot be expected to produce as many trout to a given outlay of space as the small pond system. It cannot eradicate all the conditions that cause the disease, and it is possible, even probable, that with continued

use this large pond will lose such efficacy as it possesses. This is a matter for experience to settle. Some of the old ponds at Northville will probably be replaced by excavating a large basin which shall be fed with cold spring water and contain natural vegetation. It will be stocked with brook trout and the round of fish cultural operations which involves the use of ponds will be conducted in it. It is expected to reduce materially the losses from disease, but whether as a permanent system it will give satisfactory returns remains to be seen.

The question of the value of cement ponds as a construction for small ponds in general, aside from any question of disease, will I hope be tried out by the experience of the fish culturist. I think they have made a favorable impression at the outset and possibly continued use may show that their greater durability, cleanliness, and sightliness, will more than compensate their greater initial cost.

DISCUSSION OF MR. MARSH'S PAPER.

Dr. Birge: I should be glad if Prof. Marsh would say a little as to the nature of the organism he describes, as to whether it is a baccillus or a coccus.

Mr. Marsh: It appears as every form that a bacterium takes, and when one sees it under the microscope in the tissues it is plainly a bacillus; but when you isolate it on solid media outside of the fish it is plainly a coccus, and yet it is the same thing.

Dr. Birge: How is it in liquid media?

Mr. Marsh: It is intermediate, a short rod.

Q. Does it form spores?

A. No, it does not.

Q. Have you succeeded at all in finding it in the water?

A. That is what I have been attempting to learn during my last trip to Northville. I have been there about a week, but have not got it yet.

Q. Does it form a characteristic growth on plates?

A. Yes, it does. The colony resembles a number of other water organisms and is not so strongly characterized that you can readily tell it from these.

Q. Does it liquify?

A. It liquifies rapidly.

Q. Has any disease of fish previous to this case been traced definitely to bacteria?

A. Well, in Europe several bacteria have been described as coming from fishes.

Dr. Birge: I know that.

Mr. Marsh: But the organism has not been proved to be the cause of the disease. They merely mention it in that way. I really do not know of any case where this relation has been established, but you see, very little work has been done in that direction.

Dr. Birge: There was a time when I knew something about this general line of subjects, but since I have been engaged almost exclusively in executive work during the last four or five years, I have not kept so closely in touch with this work as I should have liked to do. Those who look at these matters from a practical rather than a scientific point of view, ought to appreciate that this work of Prof. Marsh's is of very great scientific interest. Although a vast number of water bacteria have been described, yet very few, if any, diseases of water animals have been shown to be attributable to such bacteria. Indeed when I used to keep up with the literature, the statement used to be made that there were no pathogenic water bacteria affecting water animals, although there were some pathogenic bacteria that could live in water for a certain length of time, but that none of the various diseases that affect fish and other fresh water animals were due to bacteria. On the other hand, that there were many diseases due to the coccidia, a totally different group of organisms, belonging, probably, to the animal side. It is quite a triumph for American science to have demonstrated so conclusively as Prof. Marsh has done, the relation between this important disease and bacteria. It is a hopeless kind of thing, however from the practical side, apparently, to demonstrate, because it seems impossible for us to do anything either to ward off the attack or, I suspect, to cure it after it is started.

Prof. Marsh: I have no hope whatever of a cure, although a year ago we tried formalin, but it was of no use.

Dr. Birge: How far are the springs in this case from the pond?

Prof. Marsh: Mr. Clark, I think, will tell you the exact distance. It is a few rods, I think.

Dr. Birge: You speak of these organisms as being in the springs. They ought not to be in the spring water, as it comes out of the ground.

Mr. Clark: The springs that Prof. Marsh has spoken of flow into the ponds, I should say, about 90 or 95 feet from the source; but from the upper or main spring it is probably 300 to 350 feet or a little further to the ponds. The water runs in a sort of an open, paved ditch and through one series of ponds. In another series it comes down through a pipe into a little pond and then passes underground, these two being all that are supplied from the main spring. Mr. Marsh's cultures are being made from waters of both springs.

Mr. Marsh: When Dr. Birge speaks of its being strange that bacteria should come from the water as the water comes from the ground, it does seem rather peculiar; but that must be the case, because the fry in the hatchery in the troughs now have the disease, or take it, or have had it; and one can hardly imagine how they could get it from the trough, and I do not think there is any infection introduced on the way from the spring to the trough. Whenever any trout are put in these spring waters they take the disease, and the spring water itself, as it comes from the ground, is much more to be suspected than the conduits through which it is carried.

Dr. Birge: I have no doubt that the bacteria are in the spring hole, but that they are in the water as it comes out of the ground seems remarkable.

Mr. Marsh: I go as far as that, too. The bacteria are localized in the spring and the only source of infection appears to be the ground. We disinfected the spring so thoroughly with chloride of lime that it looked as though we had killed everything in it, but the disinfection did not improve the remarkable condition.

Mr. Clark: But it pretty near killed some cattle several miles away.

Dr. Birge: The logical conclusion from that statement is that the baccillus is apparently tougher than a cow. (Laughter).

Mr. Marsh: It is strange, for if the infection comes from

the water why is it not more widespread and why does it not appear in all springs? My idea is that it is a freak of nature and a condition that we must simply accept.

Mr. Clark: I would mention one thing, perhaps, for Dr. Birge's information that Prof. Marsh did not state: The spring that is flowing entirely into the cement pond does not touch the air until it reaches this pond where the trouble exists. It commences under the northwest corner of our new hatchery and flows under the wall, through tile, and comes out near the lower corner of the building in a crock and iron pipe; it is all underground until entering this pond, and is the only source of water to it. The pond is impervious no water being able to enter through the sides or bottom. We even went so far as to tile-drain a little spring away that is under the cement.

Dr. Birge: It is entirely possible that the bacteria should have been introduced in these troughs. You say some trout began to die very soon after the water was introduced through them.

Prof. Marsh: Yes. That was on account of the injured snouts of the fish mentioned in my paper, which rendered the fish liable to infection from any pathogenic organisms with which the abraded surface came in contact.

Dr. Birge: How were those trout transported to the spring, to your hatchery?

Prof. Marsh: In the fish cans ordinarily used for that purpose.

Q. Could not the germ have been in those cans. Had not those cans been used where they could get the germ?

A. I do not know where they had been.

Q. Was the possibility of infection there absolutely excluded?

A. No, it was not. It could not be excluded. Those cans are a possible source of infection. There were other fish brought from Osceola in ordinary fish cans; and it was a hard trip. They are the ones which lived until the winter; but they were not injured.

Dr. Birge: What you say of the injury is perfectly reasonable; that that was the cause of the rapid death of the fish. In

that case one fish infected from the can would infect the entire pond.

Prof. Marsh: The can is a possible source of infection.

Dr. Birge: But not a probable one?

A. No, because the cans are used constantly for that purpose without producing infection.

Q. You had the disease there before the fish were transported?

A. Yes, but not in these cement ponds, of course.

Mr. Clark: There is one point that Prof. Marsh did not bring up. The fry that died in the troughs last spring when he was there were receiving water from the upper spring that had never had a fish in it up to that time—later we put some in it—but up to the time the fry commenced dying in the troughs in the house, the water came from the upper spring, which never, in all of its twenty-six years had had a trout in it.

The President: What was the percentage for mortality in the trough?

Mr. Marsh: They all died, except sometimes there was a little remainder that we called immune, but a very small per cent of the whole—I cannot say just what, but not over from 1 to 5 per cent—they practically all died.

Mr. Clark: There is one point in this matter that bothers me. Prof. Marsh has now almost come to the conclusion that this infection of bacteria is in the water as it comes out of the ground. Now, if that is a fact why was it not there and why did not this peculiar disease affect our trout before a certain time, not more than two years ago? Why have we not had some of it during the whole twenty-four years previous to that time? When we did have diseased trout (and we had an epidemic once before when Prof. Gurley was there) it was not pronounced to be the same disease.

Mr. Marsh: I cannot explain why it was there many years ago, but it may be compared to volcanoes which erupt intermittently. I think it is just some natural change in the earth below which brings this organism into the water. It is some change in the constituents of the water—that is the only explanation I can make of the infection starting up as it did.

Dr. Birge: Is not there another possible explanation of it?

There are quite a number of bacteria just on the edge of being pathogenic and which are ordinarily not pathogenic. That is true of the colon bacillus. You get a particularly virulent group of them and they will cause disease, while under other conditions they do no harm; and it is perfectly conceivable that you have got a pathogenic form of a bacillus which is ordinarily not pathogenic; and then it is also possible that the resisting power of the fish has been somewhat diminished; so that it may be both of those conditions or either of them in combination which has caused the infection.

Prof. Marsh: Do I understand you to mean that this organism may have been there all the time?

Dr. Birge: If it is a water organism I should conjecture that it has been there all the time.

Prof. Marsh: Yes, but it has changed its habit—that is a very reasonable supposition, but one can never find out about it, to a certainty.

Dr. Birge: If you find this organism in the water it may be entirely possible for you to find it in the water of other hatcheries, but not developing in a pathogenic way.

Prof. Marsh: Yes.

Dr. Birge: If you get it in the water here I think you ought to look for it where the disease is not known.

Prof. Marsh: You mean attempt to find a harmless form of it somewhere else.

Dr. Birge: Yes.

Mr. Lydell: Was there any vegetation in those springs previous to this disease appearing there?

Mr. Clark: Yes, all of our water there will grow vegetation, principally of a certain kind of moss, but there is not any great quantity.

The President: Would it form a scum on the top if allowed to remain?

Mr. Clark: Oh, no sir, nothing of that kind—it is a growing vegetation of a limy nature, that is cleaned out from time to time.

INBREEDING POND-REARED TROUT.

BY ARTHUR SYKES.

In submitting this paper the writer does not profess to speak with authority on the subject under consideration nor desire to pose as a discoverer or a pioneer. If it should appear that the subject is already well understood and so simple as to be unworthy of consideration here, an apology for the writer may, perhaps, be found in the fact that he has never heard the subject discussed in any of its phases in relation to fish culture or read anything on the subject emanating from fish culturists in any journal or report, not excepting the reports of the American Fisheries Society. Much has been said and written about methods and results of propagation; but little thought, it seems, has been given to the foundation on which we work or the quality of the material of which it is composed, i. e., the potency and vigor of the parent fish and the embryo.

So far as the writer has been able to ascertain the principles underlying the breeding of domestic animals, here exploited, have not been applied in fish culture excepting in a very limited way; and no fish culturist has put those principles to a practical and complete test. If, however, my knowledge of what has or is being done is not complete or my surmises not entirely correct, it is hoped that the attention now called to the subject may be of use to some breeder; and that a thorough discussion of the subject by the Society may be had for the benefit of those who, like the writer, confess to a mediocre knowledge of an important subject while willing to contribute his mite.

The first stock for the pond culture of trout was doubtless obtained from waters in which the fish was found in its primitive state. It was with this stock that the protected propagation of trout in ponds on a large scale was begun. The method of breeding pursued, which is still in general practice, is as follows: The spawn is taken from the female fish of the breeding stock, large and small indiscriminately. The eggs thus taken are fertilized with milt obtained from the male fish of the stock with the same

lack of regard as to the size, vigor and color of the fish. In this process, I repeat, little or no attention is paid to the size, vigor, or color of the fish spawned. Everything is threshed out, so to speak, that will produce eggs and everything is stripped that will produce milt.

The eggs thus taken are laid down in hatching troughs and incubated. The first of the season's crop of fry is usually saved for the use of the hatchery to increase and replenish the breeding stock in the ponds. The remainder of the crop is sold by the private hatchery or planted in public streams by the state hatchery as the case may be. The fry saved for the use of the hatchery is transferred to ponds, and here protected from enemies without, and as far as possible from cannibalism within. This system has been called protected propagation, and very properly, for you will note that unlike their brook-reared cousins, they are protected from beginning to end.

In saving the first of the season's crop for the hatchery ponds the fish culturist, or many of them at least, take the first of two steps in practice toward keeping the stock of trout in their ponds from deteriorating in quality, size and color. The second step consists of purchasing from time to time a few thousand eggs or fry from some other hatchery where the fish are bred in exactly the same haphazard way as a rule.

The first of the season's crop of fry is saved as it is found to be stronger, larger and perhaps more hardy than the fry hatched later. The early hatched fry usually comes from the older fish, hence has not been inbred as much as that hatched later. Fry is purchased from other hatcheries for the infusion of new blood in the breeding stock. This, with some variation in individual cases, is, in a general way, the system of trout breeding in vogue.

The results of this system of breeding under the writer's observation are, that the fish deteriorate in color, size, vigor and productiveness. A considerable number of barren fish are found. The markings of the fish are variable and indistinct, and the color of the flesh changes from pink to white.

It is possible, perhaps probable, that all the defects noted here in pond cultured trout are not due to what I consider a loose system of breeding; but it has been established almost beyond doubt that deterioration along the lines mentioned takes place in

breeding domestic fowl, animals and plants under a similar haphazard system: and I deem it fair to assume that if we get similar results from a similar system that the same causes have produced those results.

Sir James Gibson-Maitland, Scotland's greatest fish culturist, in speaking against the introduction of foreign trout into the streams of Scotland said, "Civilization must breed its trout as its cattle, or civilization will have no trout." The truth of this statement is evident to me, though I have no doubt he wrought better than he knew.

The ordinary breeder of domestic animals considers it necessary to introduce new blood into his yards from time to time by selecting a male to breed to his stock. In making this selection he does not choose a scrawny, undersized specimen, but obtains the best his means and other circumstances permit. He saves the best specimens of his flock to mate to the male thus selected, and in this way he prevents degeneration of his stock and perhaps increases their size and usefulness.

The fish culturist does not as a rule make a selection of his stock with a view to increasing the size and hence the usefulness of the individuals. His matings are haphazard and the results of a corresponding nature. It is true that he introduces new blood into his ponds, but of what avail is such new blood if it is of the same quality as the old?

The careful and precise breeder of domestic animals selects and breeds his stock to the end that he may improve them, and to perpetuate the good qualities in the offspring from generation to generation; but the system practiced by the trout culturist has for its only object the perpetuity of the species, and the results indicate that he would ultimately fail even in this.

Among wild birds and animals, and I may say fishes, the law of natural selection operates to insure indefinitely the continued existence of the species until the environment changes in such manner as to cut off its existence without regard to the natural laws of breeding. In their primeval state, there is no question but birds, animals and fishes inbreed closely; but the laws of nature operate in such manner that only the strongest and most vigorous of the offspring survive and reproduce. The weaklings

are destroyed by the inclemencies of the weather or their natural enemies.

The markings of the individuals of the same sex in most species do not vary under the same environment in the wild state. It is claimed that a dozen quail of the same sex taken from as many different localities in the United States would show little or no variation in the markings of their plumage; and the species does not perceptibly vary in size at maturity. It is probable that if a single pair of strong vigorous quail were again released as in the time of Noah and were to multiply and their progeny live through centuries in fields constantly rich with food, yet so surrounded with natural enemies and subject to such conditions as would tend to cut off the weaklings of the progeny, they would increase in size as a species; and notwithstanding inbreeding would be perpetuated indefinitely. If the food supply was insufficient doubtless the species would decline in size. If no conditions prevailed to cut off the weaklings and inbreeding occurred for any extended period, the species would dwindle away.

Nature's laws provide for the indefinite existence of the species and the environment largely determines its physical characteristics.

The breeder of domestic animals and fowl conforms to Nature's laws by permitting only the largest, strongest and most vigorous of his flock to reproduce. He fixes the environment in such manner that the desired size is insured and thus maintains or increases their size as a whole or a species from generation to generation. He may inbreed closely for many years, perhaps indefinitely, yet by careful selection not impair the size or vigor of the individuals of his flock; but on the contrary most certainly add to their beauty and their usefulness. In like manner, the fish culturist can in my opinion, by careful selection of his breeding stock produce a fish of uniform markings, of larger size, of increased vigor and greater beauty and usefulness.

I have no doubt but many practical men will regard as visionary and impractical the theories here advanced when applied to fish culture in ponds; but with some knowledge of breeding of domestic animals, after eleven years of service at a trout hatchery and much of this time given to the practical workings thereof,

the writer is convinced that these theories can be applied in the pond culture of trout and that they will mean something when so applied. They will mean that the trout in our ponds will be more vigorous and healthy: that they will be larger; that they will produce more spawn; that a larger per cent of the spawn will hatch; that a larger per cent of the fry will live; that the output of the hatcheries will be increased; that more trout will be planted in our public streams; and that larger and handsomer trout and more of them will be taken from those streams with greater delight and satisfaction to the fisherman.

The system of breeding which I have sketched here would entail but little extra expense or trouble on the trout culturist. The only additional apparatus needed in the usual outfit for taking spawn at a hatchery would be an extra tank to hold a few of the finest specimens found in the ponds.

The usual procedure in taking spawn at a trout hatchery is to confine the fish to a spawning pen or raceway and with a dip net transfer a few at a time to a tub containing some water, from whence they are handled by the spawn takers. The extra tank mentioned should be located near by and supplied with water, and whenever the spawn takers find a nice specimen of either sex, strong in size, color and markings, such specimen should be transferred to the tank mentioned. After the regular stock of breeding trout has been handled over, the eggs may be taken from the fish in the tank and fertilized by the best males saved for the purpose; and the eggs thus obtained should be given a separate place in the hatchery. The fry from these eggs should be kept separate and finally transferred to the hatchery ponds to form a part of the hatchery breeding stock. No other fry should be saved for breeding purposes.

When it is thought desirable to introduce new blood, this should be done by obtaining a number of mature specimens of good size, color, etc., to be used in connection with the selected breeders from the home stock rather than by purchasing a large quantity of fry or eggs bred in the usual way.

The mature fish selected for the introduction of new blood may or may not be wild fish. If the progeny is to be planted in wild, unprotected streams, wild fish would be preferable for this

purpose; but in either case the specimens selected should be of good size, color and markings.

I am convinced that the law of "Like begets like" applies in the same manner and to the same extent in the propagation of fish that it does in breeding domestic animals; and if it is desirable and profitable that only the fittest be selected in breeding in the one case, it is just as desirable and just as necessary that such selection be made in the other.

We should aim to improve the quality of the fish in our ponds and through them the quality of the fish planted in the streams. That there is room for improvement here is indicated by the fact that many expert fishermen claim to be able to tell from the appearance of the brook trout they catch in our streams whether the fish was planted from a hatchery or came from the wild stock in the stream. I do not believe this is possible as a rule, but it is quite likely that the old trout fisherman can see a difference in the color and markings of the hatchery trout which he catches today as compared with the wild fish which he caught twenty-five years ago.

If we are right in claiming that the quantity of trout which our streams produce is dependent on our hatcheries, then we must also be held responsible in a large measure for the quality; and in this connection the fish culturist should always remember that on the vigor of the parent stock depends, not only the quality of the offspring, but the quantity as well.

DISCUSSION OF MR. SYKES' PAPER.

Mr. Titcomb: I heartily concur with the writer in all that he has said about inbreeding and getting a good quality of fish by introducing new stock, and I may perhaps say in that connection that the commercial fish culturists almost all do that in the East. On the Massachusetts coast where the commercial hatcheries are so plentiful, they very frequently call upon us for the eggs of the wild trout and rear those to mix with their brood stock, and thus obtain new blood. Some of the hatcheries introduce new blood by that method every year. I think that this idea can be carried out beyond the commercial hatcheries and beyond our brood stocks at any of our state hatcheries. I think that the changing around of the stock of trout in our natural

ponds will tend to strongly invigorate the trout. In traveling through the trout country of the Laurentian Mountains in Canada I was very much surprised to find lakes teeming with trout where the stock had apparently run down. I could not find any other reason for it except in breeding. The ponds were of large size, full of food, but the fish were small and the eggs of very inferior quality. In fact, at one place where I was trying to collect the spawn of the wild trout in the Laurentian Mountains, we took something like 6,000 fish on the spawning beds, and in a week's time got less than 100,000 eggs from those fish. The eggs were inferior and seemed to be diseased. The fish themselves were apparently all right—good eating, and rather thin, notwithstanding the abundance of food. That idea of introducing new stock I think should be carried out very frequently in connection with our work. I have carried out that idea, so far as possible, in connection with the collection of eggs of the wild trout from different waters. When returning a proper quota of product of these eggs to the waters where we made our collections, instead of returning the product of the eggs that were collected at any particular station, we took the hatch of eggs taken from some other point, and each year changed them around, so that at all of our collecting stations new blood was introduced annually.

Dr. Birge: I would like to ask whether any fish culturists have tried this method Mr. Sykes speaks of of selecting the individual fish to breed from to keep up the stock of breeders.

Mr. Titcomb: I know to a certainty that one of the fish culturists in Mr. Lane's neighborhood selects the larger fry—that is, when he sorts out his fry he takes the larger ones. Sometimes you will find, as you know, fry two inches long in with fry of the same age or about an inch in length.

Another point we might consider is that the commercial fish culturists are rearing trout for the market, and the market demands a small fish. The result is that they are taking most of their eggs from fish a year and a half old, what we call yearlings, and those eggs are very inferior to the eggs of the fish a year older. The United States Commission in obtaining eggs have adopted a rule not to accept any eggs from fish less than two and a half years old, for that reason, but the tendency of distributing

these eggs from the younger fish all round the country, selling them to state commissions and private hatcheries, is toward the introduction of an inferior fish.

Mr. Lane: I would state for the benefit of the society that I always manage to select my fish from the eighteen months' old fish, but I select them when they are fingerlings; that is, I will, for instance, select them this fall from the fish hatched this spring, and from those fish I take the stock to replenish my stock with. As Mr. Titcomb says, I have introduced new eggs from other hatcheries, but I never have thought that the inbreeding ever hurt my fish at all. I have not seen any ill effects of it. But I have only been at it seven years, and perhaps it would not occur in that time.

Mr. Titcomb: Introducing eggs from other hatcheries counterbalances the inbreeding.

Mr. Lane: I never thought that they did deteriorate by inbreeding, because of putting in this new blood—that is what I meant to infer, that the introducing of this new stock kept the old stock up to the standard.

Mr.Titcomb: That is just the point he makes, that you should do that.

Mr. Lane: That is what I have done. But I have saved the stock on the very principle that you mentioned, that the market does not require large fish. When I send them to New York for food they do not want over half-pound fish; they will take them as high as three-quarters of a pound, but from one-quarter to one-half a pound is as big as they want; and in that way good, nice fingerlings and two years old are plenty large enough. So we do not keep fish until they are two and a half years old; we cannot keep them to sell many eggs from, and that is the reason that these commercial hatcheries sell them young and have nothing but the eighteen months old fish to take the eggs from.

Mr. Clark: There is one point in this paper in which I do not quite agree with Mr. Sykes, and that is in reference to the color of the eggs of fish that are bred in and in. I had the impression from the paper that the color of the eggs indicated that the fish had been so bred.

Dr. Birge: I did not so understand it.

The President: He thought the markings became less distinct and clear.

Mr. Clark: He spoke of the eggs.

Dr. Birge: I recall nothing of the sort. He mentioned selecting fish of good colors.

FEEDING: ITS EFFECT ON GROWTH AND EGG PRODUCTION.

BY W. T. THOMPSON.

The relation of food to growth and production has ever been a most interesting subject for speculation and experiment; not alone to fish culturists or to the present generation, but to all mankind and throughout all ages this problem, in its broader sense, has appealed to each individual in a peculiarly personal way. The farmer studies his soil, what food will best promote the growth of his crops, and enable him to reap the largest harvest from his fields. The stockman, that he may produce the best quality of beef, mutton or pork in the shortest time, and with the largest margin of profit. It is a subject pregnant with interest to the gardener and the horticulturist. It appeals to the machinist and engine driver, what fuel will produce the most power at the least expense? It is not absent from one single vocation. It is a strongly pertinent query even in the home life, what foods or combination of foods will promote the best growth and development of the children; preserve the health and strength of the adults; prolong the period of productiveness and usefulness in the bread-winners?

In the earliest dawn of history, we read of families, tribes and even nations, migrating from place to place to secure better and more abundant pasturage for their flocks and herds, thereby increasing their own food supply. This was one of the very first questions man was called on to grapple with. It still presents a splendid field for investigation and experiment. At no time has it received a larger share of attention than it does today. Scientists and chemists of the highest order are giving this food problem their closest attention. The question of constituents, proportion, amount, ease of assimilation, etc., is still puzzling the wisest minds.

My own study has not been limited to the circumscribed area included by my topic. It has been my privilege and pleasure to consider it in its broader relations to animal and plant life gen-

erally. Each germ, each embryo has its possibilities, whether it ever attains to them or in what measure it falls short depends on the surrounding conditions during the period of growth, whether these be favorable or the reverse. Herein this same question of food supply assumes a position of primary importance. The Percheron and the Clydesdale, with their grand proportions, their majestic bearing and their remarkable strength, trace back to the same ancestry as the shaggy, diminutive Shetland. The food conditions have been different. There is but little resemblance between the luscious Northern Spy or Baldwin from our highly fed and cultivated orchards, and the wild crab or seedling growing by the wayside.

In the present paper I shall consider the food question in its relation to fish life only from the standpoint of quantity. The consideration of its quality, its proper combinations of elements to produce the best results, being left for some later day, perhaps for some later generation. We will assume that experience has, to some extent, taught each fish culturist what food or foods are the most economical and satisfactory under his own peculiar conditions.

The results which I shall endeavor to bring to your attention were not obtained in experimental work under peculiarly favorable conditions, but where the outcome of the regular work of the Nashua Station, under charge of Superintendent Waldo F. Hubbard, and obtained in spite of the usual drawbacks incident to a first season's work at any new station. There was no intention of producing any abnormal growth of egg production, merely to ascertain in a practical way the effect varying quantities of food would have on health and growth. Later the matter of egg production was also included.

The lot of fish in question were brook trout, numbering about 5,000, hatched in the spring of 1900, and were reserved from the fall distribution to be reared for breeders. Prior to this time, they were all treated alike, fed generously on beef liver, which diet was continued throughout the entire period. About the first of October, 1900, they were sub-divided into four lots and placed in winter quarters. At this time they averaged from one and a half to two pounds per 100. Lot No. 1 received practically all they would eat. Lot No. 2 about 80 per cent, while Lot No. 3

were fed 65 per cent, and Lot No. 4 only about 50 per cent of their capacity. Lot No. 4 was in a larger pond where they secured some natural food in addition to their daily rations. From this time until the following August they were fed twice per day, then but once till the commencement of the spawning season (November) when they were fed but three times per week. No markd difference was noted as to health amongst the various lots, although the death rate, which was only nominal, was a trifle higher amongst the smaller fish. In the matter of growth however the difference was most markedly in favor of those receiving the larger rations. A monthly record of the growth of Lot No. 1 was kept for one year, as follows:

Weight per 100 fish:

Oct.	Nov.	Dec.	Jan.	Feb.	Mch.	Apr.	May	June	July	Aug	Sept.	Oct
2 lbs.	4½	5¾	8¼	11	12¾	16	20	28	34	45	55	60

This included both males and females, the former being naturally somewhat larger. One day during the spawning season ten representative females were selected from each lot and weighed, prior to stripping, to ascertain the comparative growth:

Ten fish from

	Lot No. 1.	Lot No. 2.	Lot No. 3.	Lot No. 4.
Weighed	5½	3½	2¾	2

Spawning was practically over by December 18th, and the few spawners remaining in the various lots were put together for convenience, but these unripe fish are noted with their proper lot in the spawning summary which follows:

SPAWNING SUMMARY TO DEC. 18, 1901, INCLUSIVE.

	Lot No. 1	Lot No. 2	Lot No. 3	Lot No. 4	Total
Females spawned,.....	111	351	513	735	1710
Barren females,..	none	20	27	55	102
Total Fem in spawning sum..	111	371	540	790	1812
Per cent females spawning...	100	95	95	93	94
Per cent females barren,. ...	0	5	5	7	6
Eggs taken,.....	104,400	199,800	234,900	285,750	824,850
Average No. Eggs per fish,...	940	560	458	389	482
Females unripe Dec. 18,... ..	16	51	39	23	129
Total females including above,	127	422	579	813	1941
Total males (lots not kept separate)	.....	.....	.....	.....	3102
Total males and females,.....	.....	.....	.....	.....	5043
Per cent females,.....	.....	.....	.....	.....	38.5
Per cent males,.....	.....	.....	.....	.....	61.5
Average size (inches)	10–12	8¼–10½	7–9	6–7½	.....
Aver. weight females only (oz)	8.8	5.6	4.4	3.2	.....

Now let us assume for the sake of comparison that Lot No. 4 is an average of the twenty-one months' old brook trout reared throughout the country. Certainly fish of this age weighing 3.2 ounces, probably 3.5 ounces with males included, (commercial fish culturists begin to market their fish the following April when they desire a standard weight of 5 ounces or three fish to the pound) with 93 per cent yielding spawn, averaging 389 eggs each, would seem to be up to the standard, and we obtain the following convincing showing as to the value of the extra food supply:

	Per cent extra food	Weight oz.	Excess wt. oz.	Per cent extra weight	No. Eggs	Excess Eggs	Per cent excess Eggs	No. Eggs to the Liq. oz.
No. 4	.....	3.2	.....	.....	389	.....	.....	460
No. 3	30	4.4	1.2	37.5	458	69	19	450
No. 2	60	5.6	2.4	75	560	171	44	408
No. 1	100	8.8	5.6	175	940	551	141	378

A query naturally arises as to the exact source of this excess egg production. Is it the direct result of the stimulation of the ovaries, by the extra food supply, to such an extent as to increase the number of embryos on the one hand, or on the other, is the lesser nourished fish unable to develop and mature the full number of germs initiated? Courtesy to other contributors prompts me to refrain from trespassing further on the very limited time at the disposal of the society, by following up this branch of my subject further than by the suggestion that it will afford the student a very interesting and profitable field for further thought during some leisure hour.

Before closing I wish to state very positively that I do not advocate full feeding for adults. If range, temperature, and conditions generally are favorable, nothing but the best of results will follow such a course with fish under two years of age. The remarkable growth during this period coupled with the extensive demands made on the system in maturing the product of the ovaries, can only be provided for by a most generous system of feeding.

For the benefit of those who may wish to study this matter more closely, I attach herewith a detailed record of our spawning operations for publication in the transactions of the Society.

DETAILED RECORD OF SPAWNING, NASHUA STATION.

	LOT No. 1		LOT No. 2		LOT No. 3		LOT No. 4		Total Fish	Total Eggs
	No. of Fish spawned	No. of Eggs Taken	No. of Fish	No. of Eggs	No. of Fish	No. of Eggs	No. of Fish	No. of Eggs		
Nov. 8..	....	.....	7	4950	35	17100	104	48600	146	70650
Nov. 12.	....	.....	13	8550	9	4950	81	34650	103	48150
Nov. 14.	4	4500	15	9000	39	22050	68	29700	126	65250
Nov. 16	6	4950	18	10800	32	15750	78	31950	134	63450
Nov. 18.	5	3600	16	9000	44	18450	76	31050	141	62100
Nov. 21.	9	8100	35	20700	41	18000	32	14400	117	61200
Nov. 23	7	5850	29	17100	66	29700	52	17100	154	69750
Nov. 25.	10	9000	36	19350	48	18900	46	15700	140	62950
Nov. 27.	11	8100	28	15300	22	10800	23	6750	84	40950
Nov. 29.	4	4950	17	10800	21	17100	27	10350	69	43200
Dec. 2..	16	18450	43	28350	60	27900	30	11250	149	85950
Dec. 5..	16	13500	35	18000	50	17100	44	13950	145	62550
Dec. 7..	1	900	16	5400	9	3150	20	4950	46	14400
Dec. 9..	4	4950	14	7650	8	3150	10	3650	36	19400
Dec. 11.	5	4950	10	5400	10	2700	17	4500	42	17550
Dec. 13.	5	4500	6	3600	11	5400	8	2700	30	16200
Dec. 16.	6	6750	5	2700	5	1350	13	3150	29	13950
Dec. 18.	2	1350	8	3150	3	1350	6	1350	19	7200
Total..	111	104,400	351	199,800	513	234,900	735	285,750	1,710	824,850

FISH CULTURE ON THE FARM.

BY J. J. STRANAHAN.

It is safe to presume that the members of the society will think that this subject has been selected because the writer is too lazy to prepare a paper along more scientific lines and if this be the case, the presumption will be well founded, although much of interest and value may be said on fish culture on the farm, a subject that has been too long neglected by this association, the United States and state fish commissions and by fishculturists generally.

With our public waters rapidly becoming depleted through excessive fishing, in spite of the good work being done by the hatcheries, where are we to look for the fish to fill the very rapidly growing demand, if not through water farming? Of course the output of ocean, lake and stream may be held in statu quo or possibly increased to some extent by reasonable restrictive laws and by the work of fishculturists, but with the rapid increase of our population and the further growth of consumption through improved transportation facilities, the limit has doubtless already been reached and any permanent increase of per capita supply must come through covering what is now unproductive land with water, thus adding to the output of fish beyond what natural waters would make it, and making many fins grow where none at all grew before.

There are vast areas in all of the states, probably equal in the aggregate to that of the Great Lakes, which now produce virtually nothing and much of which might be made to furnish abundance of fish, with comparatively little expense.

Not only would the conversion of this waste land into water areas increase and equalize the rainfall to some extent, but it would measurably decrease the liability to disastrous floods and equalize the flow of streams. But this is only incidental to my text and not really germane to the subject.

Fishculture on the farm is, nine times out of ten, a failure, and generally so because of three main causes, none of which,

owing to lack of space, can be fully treated here. We will take first in order the failure to properly construct the embankments which are to retain the water. Very briefly stated, the sods, brush, grass and other rubbish should be cleaned away down to the solid earth over the whole extent that is to be covered by the embankment. Then a trench say two feet wide and as deep should be plowed lengthwise throughout the whole extent that is to be covered by the embankment. The earth of the embankment settles into this preventing leaks which are almost sure to follow along the union of the old and well packed earth and the new soil, if this is not done. No brush, sods, stumps or other rubbish should be permitted to enter the embankment. Use nothing but clear earth and if the soil be gravely to the extent that it is likely to permit the water to filter through the inner face of the embankment, that is, the one next to the water, should be faced with a foot of clay or other impervious soil. The plow and scraper will be found the most economical, unless the lay of the ground is such as to prevent, when wheel barrows will be necessary, and the team should be kept on the embankment while going and coming as much as possible, so that the earth will be packed as much as possible and prevent sloughing when the water is let on. If the embankment is made of proper width at the bottom and the correct slant given to the sides—observe the slant given by nature in your vicinity—you will have an embankment that will last for generations and give you no trouble.

All ponds should be provided with a sluice or outflow through which the ordinary discharge flows and through which also you may discharge the water when you wish to draw down your pond, a matter strictly indispensable to successful pond culture. The sluice may be most economically made of two-inch plank a foot wide and should be long enough to go clear through the embankment, the outflow, or perpendicular part being securely spiked to the horizontal part which runs through the embankment and is situated low enough to draw the water entirely out of the pond. The face of the upright, that is, the side opening towards the pond, is, of course, left open, the box being closed on three sides, the open side being left for the discharge of the water. Two grooves should be provided by

nailing three strips onto each side plank of the upright. Into the back groove boards an inch thick and three or four wide are slipped, these retaining the water at its proper height, the surplus being discharged over the top board, and these being removed one at a time when you wish to lower or empty your pond. Into the front groove the frame of your screen is slipped from above. This should be covered with galvanized wire cloth with about one-half inch mesh. This should be used only when the pond is being emptied or lowered, for the few fry which will escape ordinarily amounts to nothing, in fact, you are sure to have too many after your first hatch in any event.

The second cause of failure is the selection of too high-toned fish and the introduction of too many species. Not over two or three species should be put into any pond of a few acres or less, and the more desirable ones from your vicinity are likely to prove the most successful. To introduce brook trout, unless you have a very large spring of cold water, will lead to failure, and no matter how much water you have and how cold it is, you would better leave the trout alone unless you know something of their culture or wish to study their habits and make a pastime of their cultivation. The same is true of the black bass, unless you have a pond of several acres or wish to sacrifice a good supply of fish for your table for the sport of capturing a few bass with rod and line, which, after all, can be best accomplished in some nearby public water, leaving your pond for the cultivation of those fish which will provide you the maximum of good food with the minimum of trouble and expense. If black bass is decided on, in nine cases out of ten, north or south—the small-mouth is not indigenous to the south south of north Georgia—the large-mouth species should be selected, the only exception being where the pond is supplied with an abundant supply of cold water and where the bottom of the pond is gravely or rocky throughout a considerable portion of its area. If the bottom of the pond is soft, suitable for the growth of aquatic vegetation, then the large-mouth should be introduced by all means, if bass are to be selected at all.

The best all round fish for small ponds, north or south, is, in the opinion of the writer, what is known as the marble or mottled catfish in the north and the speckled cat in the south,

Ameiurus nebulosis, from nebulous, clouded, which is easily identified by its square tail, which is not forked in the slightest degree, and by its mottled skin north, while in the south it is covered with black specks on a light slate background. This is an excellent fish, making a rapid growth for the first two years in particular, cleanly in its feeding habits, being in no sense a scavenger, almost omnivorous in its selection of food and growing to weight two or three pounds, often attaining to one pound when a year old, when the range is ample and the food abundant. This fish does not interfere with other species in the pond, either through destroying the young or the eggs of the other. In fact, any nest-builder, such as the rock bass, black bass, bream or sunfish will defend its nest and eggs against all comers, even if it be a mud turtle of many times the weight of the fish. Taking it all in all, the writer believes that this fish will produce a greater weight of good food from a given area of water than any other that swims.

Taking the country as a whole, the writer believes that what is known as the blue-gill sunfish north and the bream south is the next best fish for small ponds, although he would possibly modify this statement to let in the rock bass where the water supply is especially good and the considerable gravel entering into the soil in the bottom of the pond, and it is possible that this fish may prove a desirable pond fish in the south, it having been acclimatized in Texas, where it is doing well in public waters. The blue-gill, or bream, *Lepomis pallidus,* is of excellent quality, dresses to waste but little, is a rapid grower and is esteemed by many as next only to the speckled brook trout as a pan fish, while my good friend and enthusiastic angler, Mr. C. T. Hasbrook, of Cleveland, O., claims that when taken on a fly with light tackle, he offers sport as a game fish second only to the speckled beauty of the brooks. Probably Mr. Hasbrook is the best posted gentleman in the world today on this fish, and he considers it one of the most desirable for table as well as at the end of a line. While it sometimes attains a weight of three or four pounds in the south, a pound will be found to be about the maximum for this fish in ordinary pond culture. Like the speckled cat, it is not predaceous to any appreciable extent, defending its own nest vigorously and leaving others to do the

same unmolested by him. It is omnivorous, eating almost anything that you give it, provided the food is clean and that decomposition has not set in, and finding much of its own food in the pond in the shape of small crustacea, larvae of insects, worms, etc. If rock bass are to be had in your vicinity and not the blue-gill or bream, it would probably be best to introduce them.

In stocking your pond, half a dozen pairs of each species are a great plenty and even these will overstock your pond the first year if two or three pairs of each bring off broods. It is by far the better plan to collect adult fishes from near by waters for stocking your pond. These will bring forth young two years earlier than the fry furnished by the United States or state hatcheries, besides, being acclimatized, they are likely to do better.

If black bass are to be introduced it is well to also put in brook minnows, such as chubs, shiners, suckers, etc., but care should be exercised that undesirable forms, such as pickerel, etc., do not slip in with them and lead to serious regrets later for it is easier to keep out undesirable fishes than to eradicate them when once established.

The third, and one of the most fruitful causes of failure in fish-culture on the farm, is over production. The first year's hatch of the fishes above recommended with the numbers of adults suggested, will overstock any ordinary pond of a few acres. Just as soon as the fish are large enough, probably in the fall of the year when they are hatched, the owner should begin catching them for the table. They will not be very large but sufficiently so to make a nice little pan fish and their quality will be fine. The more you can get out and consume the better. At the end of the spawning season of the second year your pond should be drawn off and the surplus fish turned into the near by stream or lake, thus paying back to nature the debt you owe her.

It is a hard matter to advise just how many fish of each species should be returned to the pond, the natural inclination being to make it too many. One hundred of your yearling black bass and twice the number of bream and catfish is plenty for each acre of water, and too many, unless you are pretty persistent in

catching them out, and not over that number of fry should be retained to come on for the coming year's supply.

To recapitulate: Make your embankment good and safe; don't try to breed too high-toned fish; look to it that your pond does not become overstocked and, other things being equal, you will succeed.

DISCUSSION OF MR. STRANAHAN'S PAPER.

Mr. Titcomb: I think Mr. Stranahan has brought out one very important point there. In the first place, this question of fish culture on the farm is very important, and it is not taken up enough in this country, and a great deal might be made of it. I can see in my work in Washington that this form of fish culture is growing very rapidly, especially in the west and southwest.

But he brought out in the paper one other point which every fish commissioner and culturist must appreciate, namely, the fact that people who know nothing about what they want will apply for some variety or species of fish that does not inhabit their waters—they want something new. Somebody up in Connecticut will send down for Calico bass, for instance, when they have black bass or trout. They may have all the fishes that are desirable in their waters, but they want something entirely new. It is a great mistake to try to get too many varieties of fish in a pond. We had an application in New England in the past week where they had black bass, pickerel, sunfish and yellow perch, and they wanted us to introduce the rock bass. In my opinion they had as many varieties as the pond could well sustain, and it is a great mistake to try to get in too many varieties.

Mr. Lane: Mr. Wood in his paper in last year's report said something about the different kinds of parent trout that they received eggs from, and I inferred that he preferred the wild trout. I have found in one instance that I shipped some trout eggs to Pennsylvania, and 50 per cent or more of them died, and the man wrote me that it was pretty near a total failure. But out of the same lot and on the same day there were some shipped into the state of Maine, and those I have been informed, hatched out 94 per cent. They were the very same eggs exactly. I wish I knew the cause of the trouble, but I think I have learned some-

thing in the discussions I have heard here on that point. Now, I would like to know what difference there is between the wild trout egg and a good, domesticated trout egg, for hatching purposes. I do not know, but I should like to.

Mr. Titcomb: That subject I have studied. I have taken every year for the last six or eight years, eggs of wild trout from different ponds and streams and have been handling at the same time the eggs of domesticated trout from commercial hatcheries. The eggs from the wild trout in every instance have proven to be the most hardy, and have produced the most hardy fish; but I am not prepared to say that your fish are not just as good for your waters. The longer I investigated this question the more I was inclined to believe that possibly these domesticated fish had become accustomed to a certain quality of water. I think Dr. Bean has touched on this point in connection with the changes brought about by domestication. My waters were all extremely cold in the winter, and these eggs of the wild trout naturally were accustomed to this extremely cold water. I think possibly that the eggs of the domesticated trout introduced into our waters suffered very much as do the rainbow trout introduced into our extremely cold waters. I do not think it is all weakness in the fish, because in many instances these domesticated eggs have been reported from other stations as yielding a very large per cent of fry, and in some cases have yielded well in fingerlings, also.

Mr. Lane: Does not the condition of the fish depend a great deal on whether they are allowed to breed in and run out, or whether new stock is introduced?

Mr. Titcomb: Oh, yes, I think you want to introduce new blood in your commercial hatcheries every year, and you cannot do that better than by introducing the product of the wild eggs.

Mr. Lane: Whether the domesticated parent trout were properly cared for is what I am trying to get at. I believe Dr. Bean said that inbreeding would injure the quality of the eggs.

Mr. Titcomb: I think if you take a commercial hatchery and rear trout year after year, and then take the product of your own brood stock and rear them up, you will gradually weaken your stock; but in these comparisons I was making between wild and domesticated eggs, I would say that I received

domesticated eggs from four different commercial hatcheries and compared them with the wild eggs, put them in the troughs right beside the wild eggs, and gave them the same treatment. No disease existed either with the wild eggs or domesticated eggs.

SOME REMARKS ON THE RAINBOW TROUT, THE TIME FOR PLANTING, ETC.

BY GEORGE A. SEAGLE.

The rainbow trout are unlike the brook trout in several respects; they grow larger and inhabit larger and warmer streams, and vary much more in form and color. Their rate of growth is hardly equal to that of the brook trout under similar conditions, but the brooks reach maturity earlier. In domestication the rainbows can hardly be considered cannibalistic in their habits, although occasionally one is observed in the act of swallowing his smaller and weaker brother. Their natural food consists chiefly of worms, larvae, crustacea and the like, but in their wild state necessity compels them to seek such food as may be found. If they do not find their preference they must accept something else, and in that way they get a taste of fish and the cannibalistic habit is established.

Much has been said and written about the time, or season, for planting trout in streams, and it seems to me that the success of the work must depend largely upon this point. In my opinion there is but one favorable season, and that is spring.

With the warming up of the waters the natural food makes its appearance, and fish planted in the streams at that time need not go hungry. They can select such food as their stomachs may dictate—worms, larvae, or young minnows. Contrast these conditions with those existing in the fall and winter months, and you have all the argument necessary in favor of spring planting. In the fall and winter the streams are practically barren of food, nothing left in them except minnows, and they have become too large to serve as food for the young trout. Therefore I would plant trout in the spring and let them keep pace with their food, and when cold weather comes on, and food becomes scarce, they will be more able to cope with the situation before them.

It has been argued that small fry are too delicate to take care of themselves in open waters, but if that be true how can we expect them to multiply in the streams? If fry from two to four

months old, and averaging from one to two inches in length, cannot survive what may we expect of the eggs, and the alevins, which have been deposited in the streams by the parent fish?

Again, if the young trout were planted in the spring season the output of the hatcheries could be more than doubled, and the assignments to the streams could therefore be made much larger. The saving in food would more than pay for the increased production, and the cost of the distribution would be lessened.

DISCUSSION OF MR. SEAGLE'S PAPER.

Mr. Seagle: Before reading my paper I desire to say in regard to it that I have expressed my views as to the matter in hand as briefly as possible. I simply want to introduce it here and have it discussed by the members of this association, and see how many, if any, agree with me.

Mr. Titcomb: Do I infer from your paper that you would plant all trout in the spring—brook trout as well as rainbow?

Mr. Seagle: Yes, sir, I would plant them as early as possible after the spring season opens, and the waters begin to warm up.

Q. At what age after feeding—you feed for a while?

A. Yes, sir; our fish hatch from December 1st to March 1st, and I would plant them in April and May. They are then two to two and a half inches in length and in every respect, I think, able to take care of themselves.

Mr. Peabody: How large do rainbow trout grow down there?

A. Six and a half pounds is as large as we have grown any in our ponds; although they grow much larger in some sections of the country, especially in the west.

The President: You are in the southwestern part of Virginia?

Mr. Seagle: Yes.

Q. And your spring comes on a little earlier there than it does up here?

A. Yes, sir. April would be a favorable month for us, that is, in most years. We usually have nice weather, especially after the middle of April.

Mr. Peabody: Do you have the brook trout in the same streams with the rainbow trout?

A. Not naturally so. We have streams that used to be stocked with brook trout, but they are pretty well extinct now.

Q. Do they thrive together, with you?

A. I think they would, except that brook trout, of course, have more of the wild nature.

Dr. Birge: Has it been our experience, General Bryant, in Wisconsin, that the brook trout and rainbow trout would thrive in the same stream?

The President: They have been planted in the same stream, but I think the rainbow trout drift down to the larger streams and the brook trout work up toward the springs. That has been our experience. Our large rainbows are caught in the larger streams like the Willow River.

Mr. Seagle: That has been our experience also. The brook trout seek the upper waters or the colder part of the stream—clear waters. They do not thrive so well in muddy streams. Of course I do not mean to say that muddy streams are suitable for any kind of trout.

Mr. Clark: Speaking of the brook and rainbow trout inhabiting the same stream; there probably is not a better example of it than the Au Sable River in Michigan. Brook trout and rainbow trout are both thoroughly established in that stream. Of course, as you are all well aware, it was formerly the leading grayling stream in that respect in the United States, but now they are nearly all gone. On the Au Sable are found the rainbow trout, and more especially the larger ones, in below the brook trout; but where brook trout fishing is good rainbows will be taken, but they are of the smaller size. The fry of the rainbow trout and brook trout (I am speaking of fry until say July and sometimes later) are found together—I think as late as October, when we were catching parent fish there. We have taken probably as many rainbow trout fry as we did brook trout fry, with the net; so proving that they were right together. It has therefore occurred to me that the larger rainbow trout go down below simply because they are larger. I have seen these large rainbow trout in the spring of the year when they were

spawning, about the middle of March, way up the stream as far as they could go.

In speaking of the planting of fish in the spring: I do not agree with the reader entirely. I think it depends on the age and size of your fish. If you are going to plant fry, plant them before they have been fed at all—in fact plant them just before the sac is gone. If you are going to plant the others, do so after they are partially grown.

Mr. Titcomb: I do not think it is possible today to have in this society the discussions on this question that prevailed a number of years ago and which caused the subject to be tabooed, you might say. I think the fry men and fingerling men are coming together to a certain extent. Now, I have watched for the last twelve years the results from both fry and fingerlings, and I am inclined to agree with Mr. Seagle (I would not say in the spring, just as he does) but, as Mr. Clark says, it depends on the size of the fish; and what fish would be suitable to plant in April in Mr. Seagle's country could not be planted in Vermont, for instance, until July; and we there have begun the planting of fry after they have been fed two months, to thin them out and give us more room; and we then kept up the planting until they were three or four inches long. But the results with the brook trout with us seemed to be better with fingerlings; that is, with these fish that are of the age Mr. Seagle speaks about, than with the fry just after the sac is absorbed, or just before. Then you take another variety, the land-locked salmon. They were planted as fry in Vermont a number of times without any results at all; then we raised them to fingerlings and planted them in September and October in lakes, and got remarkable results. So that while it might be profitable to plant brook trout when they are quite young, my experience has been that in introducing fish into lakes, except into streams that are full of minnows, the fingerlings are far the best and produce the best results. On the other hand, in our Vermont work, we have planted the lake trout as fry just before the sac is absorbed and before they have been fed, with quite as good results as from planting them as fingerlings; and we have planted them in a lake where there were no lake trout, with very remarkable results. I think I spoke about it in the last meeting, where we

had introduced them in one lake, and in three years' time they were having splendid fishing for lake trout. So that we cannot have any hidebound rule about this thing. I like to feed the fish awhile, and I do not think we ought to plant them until they have been fed two months, if we plant them after they have been fed at all.

The President: You do not want to keep them until their spirit of self reliance is all gone.

Mr. Titcomb: I do not think there is much harm keeping them through the fall, but just as good results are obtained from planting them earlier.

The President: Some years ago there was a large surplus of male fish at the Madison hatchery, and we liberated them in a stream which was formerly a good trout stream—quite a number of hundred of them. They were fish reared in ponds and are pretty good size, and we got returns from them after awhile, people caught them, some months after they were deposited in the river, and they were found to be pretty nearly starvd. They did not know how to get a living.

Mr. Titcomb: Those were adult fish?

The President: Yes. Have you ever had any such experience?

A. No, sir.

The President: Those were the reports we got—there were some of them caught, but they were mere shadows, unnourished, starved.

Mr. Titcomb: Was there an abundance of fish in the stream where they were placed?

The President: It had been a good trout stream in its day—naturally—but it had been fished out.

Mr. Titcomb: I should infer that the food was gone, too.

The President: That might seem so, or that they did not adapt themselves to the new environment.

Dr. Tarleton H. Bean: Is it not probable that the reason no rule can be very well established for the distribution of all these trout and the young salmon, is that the differences between them are rather complicated? Our lake trout and land-locked salmon have different spawning habits from the brook trout and the rainbow trout. The young brook trout feed largely at the

surface, whereas the rainbow trout is a bottom feeder, and there are so many different lines of variation arising from the nature of the fish and its habits, that you cannot fix a hard and fast rule, but must be governed by experience and observation of the actual results of planting. It would be of great advantage in point of economy if a man could get rid of the fish early and get the same results as he would obtain if he held them longer before disposing of them; but you must not lose sight of the fact that we are dealing with a pretty big range of territory and habit when we talk of rainbow trout, brook trout, lake trout and land-locked salmon. They are four just as clean-cut and distinct animals as you can very well associate in aquatic life, and I do not believe we will ever arrive at a rule, except the rule of the results which experience demonstrates.

Mr. Clark: Why do you call a rainbow trout a bottom feeder? I never have been able to see a great deal of difference between rainbow and brook trout in that respect. I have seen them both take food from the bottom of the water; but the rainbow trout takes a fly quicker than the brook trout.

Dr. Bean: Because in their wild state, in the region from which they were first obtained for artificial introduction, they were observed to be bottom feeders; that is their original instinct, but fish under domestication are not wild fish and may change their nature. That should be carefully considered.

Mr. Clark: How about the wild state of the rainbow trout?

Dr. Bean: We have no wild native rainbow trout.

Mr. Clark: The ones planted wild.

Dr. Bean: We have none. We have had generation after generation of domesticated fish, fish brought up and taught new tricks.

Mr. Clark: How about the rainbow trout eggs brought here from the Pacific Coast, taken from wild fish and planted in our streams here?

Dr. Bean: How long will it take a fish to learn a new habit?

Mr. Clark: I do not see how they can get new habits when they are hatched from wild eggs and brought from wild streams.

Dr. Bean: Whitefish from Canandaigua Lake learned to eat killifish as quick as brook trout. Domestication works so many

and such sudden changes in fish life that you cannot estimate the effects, except by experience.

Mr. Titcomb: Do not the rainbow trout on the Pacific Coast in their natural habitat take the fly?

Dr. Bean: Yes, but it is known on the Pacific coast as a bottom feeder more than anything else. They may be seen boring right on the bottom, as cod do sometimes, standing on their heads and boring down. But it does not seem to do so here.

To show how domestication may change the habits of a fish, you all know about the experiment in France in the rearing of the big Pacific salmon in fresh water. Two years ago I saw in the aquarium of Paris at the Trocadero, fish hatched from the eighth generation of eggs, the parents of which had been retained in fresh water, and the fish never had access to anything but fresh water. Now, there was a sudden change of habitat and habit, and you would think it inexplicable almost, but they are all good healthy fish, although it is the eighth generation from eggs brought from the Pacific coast. It shows the wonderful influence of domestication in altering habits.

Mr. Clark: I did not question that matter at all. I am well aware that domestication changes fish naturally, but I could not see how that eggs taken from wild fish on the Pacific Coast, brought here, merely hatched on trays, and the fry be planted in a wild stream here, could be said to be in the line of domestication. That was the only point.

The President: There might be a change of environment or external conditions, such as feeding, etc.

Mr. George F. Lane, Silver Lake, Mass.: There are four weeks of their life when you do not feed them, and that in my experience domesticates them considerably.

Mr. H. D. Dean, of Neosho, Mo.: Why do not brook trout survive and thrive with us? They do not, although the rainbow trout do. I cannot take the eggs from the fish raised at the station and get any large percentage of returns from planting them in our streams.

Mr. Clark: I do not know why Mr. Dean would say that they do not thrive there, when I think at his station before he was there, they made quite a spread in the growth of brook

trout in the first year; in fact they had fish nine inches long, when we had some at the same age which were only six inches long.

Mr. Dean: That is so at the station, but you cannot take eggs from those fish and raise any percentage. What I meant was fish that had been put out. We put fish in our springs and they totally disappear.

The President: What is the quality of the water?

Mr. Dean: There is some lime in it, but it is not extraordinarily hard, although rather hard.

Mr. Titcomb: The brook trout won't live in the same waters that you find plenty of rainbow trout in.

Mr. Dean: Yes, that is the point.

Mr. Titcomb: And those waters do not reach a high temperature at any time?

Mr. Dean: The water temperature of almost all springs in Missouri runs from 56 to 58 degrees Fahrenheit—one or two run a little higher.

Mr. Peabody: It is not a question of food?

Mr. Dean: No.

Mr. Titcomb: You may ask why can't we raise rainbow trout in New England. That is the fact with us. Where the temperature of the water gets very low in the winter it seems to debilitate the adult fish, and occasionally they will die just at the season of the year when the ice is forming—it must be colder then than after the ice has covered the spring. The water is full of little sparkling crystals of ice; and while we are able to carry a stock of brood fish we get a very small percentage of eggs, and that is the case where we have obtained eggs from different sources, so that we do not have weak fish from inbreeding; and these rainbows have been introduced in New England and in New York state, and in most cases have disappeared after a short time. I have in mind one stream where rainbow trout were introduced by accident. A gentleman had a private pond and reared some rainbow trout and they got into this stream which was a natural trout stream, but the lower end of it warmed up too much in the summer for speckled trout. These rainbows held their own in that stream for a number of years, but all the best fishing was at the lower end in warm water, but they did

breed there naturally for a time—in fact at one time there were three rainbow trout to one speckled trout—and yet today you perhaps catch in that stream in the course of a season a dozen rainbow trout, but the speckled trout still holds its own. There are lots of places in Vermont where we have introduced rainbow trout, and they have entirely disappeared—just the reverse of Mr. Dean's experience in Missouri.

The President: Do you attribute it to the coldness of the water as the winter comes on?

Mr. Titcomb: I cannot think of anything except the exceedingly low temperatures, and perhaps the conditions in the spring during the spawning season are unfavorable.

Mr. Peabody: We have had the same experience in Wisconsin.

Mr. Dean: The rainbow trout attains an enormous growth in Colorado in the deep lakes.

Mr. Titcomb: With a deep water lake they can get any temperature they want. They do not get anything below 40 degrees in those deep lakes in Colorado, even in the winter. We get down 30 to 40 feet in our Vermont lakes in winter.

Dr. Birge: In Lake Mendota in 80 feet of water in the winter you get a temperature of 1 1-2 degrees Centigrade—say between 34 and 35 Fahrenheit.

Mr. Titcomb: A good deal of the water in these Vermont lakes comes from springs in the lakes. The lakes form from two to two and a half feet of ice on the surface. The temperature in the summer gets up to 80 degrees, but they have the same cool temperature on the bottom.

A FEW POINTS ON THE BLACK BASS—FOR DISCUSSION.

BY J. B. LAMKIN.

In the spring of 1900 the bass at Cold Springs, Ga., Station, commenced spawning on April 13th, in 1901 they were two weeks earlier, beginning on March 31st, while this year, 1902, they commenced March 10th, three weeks earlier than last year and five weeks sooner than the year before. One would naturally suggest that the temperature regulated this difference, but the average March water temperatures for the three years are as follows: 1900, 61.25; 1901, 62.7; 1902, 58.5. Not much attention was paid to the two weeks difference last season, especially as it was noticed that the March water temperature was slightly warmer than the previous year, but this season, with five weeks difference in spawning and with a colder March water temperature of nearly three degrees over that of 1900 it naturally attracts the attention of those interested in Fish Culture.

Another peculiarity in regard to the spawning, is that we have fewer nests per capita each year. In 1900 we had more than twice as many nests as fish in the ponds, and the spawning period extended over several months, running into August. Last year, 1901, although it was impossible to keep a complete record of all nests, as the fish were transferred to larger ponds, it was conceded by all the station force that much less nesting resulted, and that the spawning period covered a shorter time, the fish not spawning any after the middle of July. This year the scarcity of nests has been very noticeable, and the principal spawning was done in a batch, very little having occurred since April. In 1900 we only had twenty-eight breeding fish, in two ponds. In 1901, eighty-seven breeding fish in three ponds. In 1902, 212 breeding fish in five ponds, the majority of them being two and three year olds. In 1900 and 1901 the breeding fish consisted entirely of wild bass, collected from neighboring ponds and streams, a portion having been brought up from Florida. This year two and three year olds, which were raised at the station were added to the brood stock.

These are facts recorded without any comment, and presented to the society for the express purpose of bringing about discussion, in order that some light may be thrown on the subject. Perhaps the same thing occurs at other stations, but if it keeps up at the same ratio, our bass will spawn in mid-winter next season.

DISCUSSION OF MR. LAMKIN'S PAPER.

Mr. Titcomb: I suggest that it be noted on that paper that it relates to the large-mouth bass entirely.

Dr. Birge: I suppose "having twice as many nests" means that the bass spawn twice?

Mr. Stranahan: Yes, sir, and some of them seven times. We had one male that we called Brigham Young, because he was like Brigham in fathering several different nests, and he fathered two broods at the same time, one just hatched and the other swimming up and taking food, some ten days older than the first mentioned.

Mr. Clark: Does that mean twice as many nests as there were males?

Mr. Stranahan: No; it means twice as many as all of them, males and females. Mr. Lamkin was conservative in just saying twice.

Prof. Reighard: It would seem to me that the average monthly temperature could have nothing to do with the time when the fish spawn. It is a few warm days that bring on the spawning, and if you get a few warm days early in March the fish are apt to soften up and spawn, and if that does not happen the next year until April they will not spawn until April. I do not think the average monthly temperature would afford any explanation of the phenomenon.

Mr. Clark: The same is true of our whitefish and lake trout. Temperature is what controls the ripening or spawning of fish, but it is not average temperature. Of course if the water keeps very warm in the fall and the fish do not commence to run, afterward when it cools down a little they come on and immediately begin to spawn, instead of waiting as is usually done. The cold water fish need cold weather to ripen them, and the warm water fish require warm weather.

Prof. Reighard: The males in all cases among these fishes build a nest and the females come in and spawn. With the sunfish and dogfish these females go from one nest to another, so that it is possible for, say, half a dozen females to furnish spawn for a dozen or more nests. Then if cold weather comes on that batch of fish may be hatched, and these same males may make other nests—building again—then a new batch of females comes in and fills, say, another dozen nests. So you may have more nests built than you have male fish, even twice as many, but a single nest does not represent the product of a single female.

Dr. Birge: That is to say, the eggs are not all ripe at once?

Prof. Reighard: That may be.

Dr. Birge: Are not deposited?

Prof. Reighard: Yes, sir—deposited within a day, perhaps, the fish going from one nest to another, scattering these eggs over the nests built by a number of males. I do not know whether that is true of bass, but it is true of sunfish and dogfish. You may in that way get more nests than fish.

Mr. Titcomb: I should like to inquire in connection with that whether this series of nests taken care of by a small number of males necessitated one male having the care of more than one nest at a time. As I understand it, the male takes care of the nest and the eggs, fans them. Now, in the case of Brigham Young, how can he manage so many nests?

Mr. Stranahan: That condition extended over the season of nearly four months. He had only one nest at a time, and perhaps I might state that in the sixth nest that he fathered the eggs were aborted and all died, and we were rather of the opinion that he followed so soon after the brood that he had just left that he had overdone himself. (Laughter).

Mr. Lydell: Prof. Reighard's remarks are correct. The female does not necessarily get rid of all her eggs at one and the same time. The male fish takes her on the nest and when he is through with her she must leave. If she is not finished she must wait for the next fellow. She may have to visit three or four nests before she gets through. That is not true of the finny tribe alone. (Laughter). On several occasions that I know of I have had the bass spawn the second time. The most I ever had was at Cascade Springs. We had nineteen bass. (That was the

experimental stage of the work). Those nineteen bass every one made a nest. There were something like thirty or thirty-five females and we collected the fry from those nests and shipped them, and I packed up my traps and went back to Detroit supposing the season was over with. I had been there nearly a week when I got word from the man at the station to return, that the bass were spawning, and we had nineteen nests just as nice as the others were, nearly as many fish, and nearly two weeks apart. This season I have had bass that have had two broods, and we have one particular bass that has fathered two broods of fish every season in the same place in the same corner of the pond.

The President: Our experience regarding the time of spawning on one occasion surprised us. We were on one of the little lakes at the head waters of the Flambeau, forty-five miles from Lake Superior. The season was unusually cold, and we were there on the 9th of July fishing in those lakes, and our superintendent went to one of the lakes that was notably a bass lake; the small-mouth bass were abundant, and he caught quite a number, but was astonished to find that most of those he caught had not spawned, although they were pregnant with spawn. He seemed to think that unusual for that season of the year; but our season had been very cold and backward there, and that we considered the cause of such late spawning. Do you find it so, Mr. Lydell?

Mr. Lydell: We had some bass spawn this year very late. Prof. Reighard wanted to study the bass when they were spawning, and he had given it up, but after he had returned to Ann Arbor seven or eight more beds were made, and we got quite a few fry from them. I think if I drew my pond down today I would find females that had not spawned. The female requires the attention of the male before spawning, of course.

I have had as many failures in the black bass business as any one. One year at Mill Creek station I had 100 beds with eggs on them, and I did not produce 50,000 fry.

The President: We have had failures in our work. The biggest failure we had was when we made a pen in a shallow lake, where a sort of bed ran up very shallow; we fenced in a lot of bass there by a good fence, and then used your screens. But it went against us some way, and we made a distinct failure.

Mr. Clark: Is it not a fact that the experience of fish culturists has been gained largely through failures? The success of fish culture in the United States at the present time is due to our failures. If we had not had discouragements in the early life of the different classes of fish that we have been working on, I do not think fish culture would be today where it is. I have had failure upon failure all through my life, and still in the main people call me a successful fish culturist.

The President: We have grown wise through a process of elimination.

Mr. Lydell: Our Mill Creek station two years ago was so near a complete failure that the fish commission told me that if they did not have their money in there they would not stay there another minute, but I told them "You had better hang on;" there are lots of things to work out. We have got to keep on studying—don't give it up. I had there that season one hundred and some odd beds; we would have the fish all hatched on the bed and then a thunder storm would come up in the night and the fish would all be dead the next morning, and I would lay it to the thunder storm! The less a man commits himself on the bass question the less he will have to take back in five or six years from now, (laughter) because the conditions in different localities have a great deal to do with the matter.

Mr. Peabody: Which are the easiest for culture, the large-mouth or the small-mouth bass?

Mr. Lydell: In my experience I have not found any very great difference. I think you have got to be a great deal more careful in sorting your small-mouth bass than you have your large-mouth bass. On one occasion we just dumped the large-mouth bass promiscuously into the ponds, and only got five beds. Therefore, I concluded that we had five females in the lot; but they do not seem to trouble one another like the small-mouth bass. We had one year a lot of small-mouth about twelve inches long, and they were all males. They seemed to band together like a lot of outlaws. They would go around the large pond, come to a pair of bass spawning, and all dive into that nest, and I have seen ten or fifteen of them just standing on their heads and rooting the whole thing up; and I drew the pond down in the spawning season and took all those fish out and threw them

on the bank, fifty or sixty of them, and after that I got a few nice beds of bass that same season.

Mr. Dean: In relation to the time of the spawning of the bass, I would like to know if anyone has thought that possibly the age of the bass might make a difference in the time of spawning. I did not know but Mr. Lankin might find that one reason. I know the young rock bass spawn later than the older ones.

Mr. Lamkin: I don't know.

DISCOURAGEMENTS IN BASS CULTURE.

BY H. D. DEAN.

This is a wide subject, too wide for the limited time at my disposal, but I will endeavor to present a few facts which have occurred during my five years experience at a bass station.

One of the greatest trials in fish culture, especially bass culture, is the fact that it takes a year to try an experiment, consequently experience is acquired slowly and, while we are trying our theories, the years slip by.

One year we may have a good crop of bass and the next season, under the same conditions, so far as we know, we have almost a failure.

At the Neosho Station we have tried many schemes that seemed feasible under the conditions existing at that station. At first the breeders were placed in the ponds in March; the ponds were drawn in July and the young fish transferred to hatching troughs; the fish were taught to take artificial food and thus carried until distribution which usually commenced about October 1st. Afterwards the troughs were placed outside where they could be supplied with water from one of the ponds at a temperature of from 65 to 77. This plan worked very well, but the young fish did not grow very fast and it entailed a large amount of work in feeding and caring for the fish. Again some of the small fish about one-half inch long, were brought to the hatchery and taught to take food and a good per centum raised, but they were very small and it was concluded that it would not be practical to raise large numbers in this manner.

One year about six thousand fry three quarters of an inch long, were seined from the spawning pond and transferred to a small pond well filled with vegetable and animal life; two months later this pond was drawn and a little over eight hundred fine bass taken out. This result was too small to be of practical value.

Another year, two of the ponds were fitted with partitions so the breeders could be placed in a small portion of the pond for

spawning and at schooling time the young could pass through the screens into the main body of the pond. The water was too low to give this plan a fair trial and the only thing learned was, that the young fry were much larger and fewer in number than usual.

This year the ponds were drawn in June, in hopes that more fish could be saved. Over seven thousand were taken from one pond and placed in another pond which was in good condition and after thirty-six days this pond was drawn and but 2,650 fish found. Some of these were very large—one was measured and found to be six and one-half inches long and weighed two and one-half ounces.

There are several other things that vitally affect the raising of bass, vegetation, natural food, water temperature, supply, etc. Sometimes it seems impossible to get vegetation to grow in a pond and unless there is a good growth of plant life, there will be no fish; that is, no great number and if there is a good growth of water plants, then the prospects for fish are much better.

There are plenty of crayfish in the ponds at Neosho and a fair quantity of other natural food. We also put in top-minnows and try to keep a good stock of food for the fish, but so far have failed to raise fingerling bass in the numbers desired.

One thing that has hindered the work, has been the fact that we have been almost constantly working at the ponds and grounds to get them in shape for good work and we are now getting them in that condition. The water supply, also, has been deficient at times and that has affected the work.

I have always been of the opinion, that the sooner the young fish could be taken from the ponds and placed in small nursery pools or troughs, where they can be constantly under supervision and easily kept sorted, the more fish can be raised. Mr. Leary of the Texas station, is working on this line with excellent results. This plan means that there must be plenty of natural food for the young fry until they can be taught to take the artificial food.

In fact the greatest failure in the raising of bass, is the failure to raise natural food in sufficient quantities at the right time, for the young fry. There is never any difficulty in getting large numbers of eggs and fry, and if the fish were distributed when they were schooling or even when one inch long, there

would not be much difficulty in sending them out in large numbers. But the great problem is to prevent their eating each other before they are large enough to take artificial food.

If all the breeders in one pond would spawn at one time so the young would be practically all one size, then the danger of cannabalism would be much lessened. A superintendent of one of the state commissions told me that he had accomplished this by holding the breeders in spring water, at even temperature, all winter, then placing them in the breeding ponds ten days or two weeks before spawning, and they all spawned at once. Well this sounded alluring and I experimented with a few fish, with the result of another failure to add to the list—these fish did not spawn at all that year. But "Hope springs eternal" and next year we hope to raise a large crop of large mouth black bass.

LIST OF MEMBERS.

ACTIVE.

Adams, E. W., 114 Wall Street, New York.
Adams, Fred J., Grand Rapids, Mich.
Ainsworth, C. E., Sault Ste. Marie, Mich.
Ainsworth, G. G., United States Fish Commission, Leadville, Col.
Allen, A. D., Flora, Ore.
Allen, G. R., Roxbury, Vt.
Alexander, George L., Grayling, Mich.
Alexander, L. D., 50 Broadway, New York.
Anderson, J. F., 240 Eleventh Street, Jersey City, N. J.
Andrews, Barschall, Columbus, Ga.
Annin, James, Jr., Caledonia, N. Y.
Ashford, W. T., 711 Prudential Building, Atlanta, Ga.
Atkins, Chas. G., East Orland, Me.
Ayer, F. W., Bangor, Me.
Babbitt, A. C., Williamsburg, Mich.
Babcock, John P., Fisheries Commissioner, Victoria, British Columbia, Can.
Bailey, H. W., Newbury, Vt.
Baldwin, O. N., United States Fish Commission, San Marcos, Tex.
Ball, E. M., Leadville, Colo.
Barrett, W. W., Church's Ferry, North Dak.
Bartlett, Dr. S. P., Quincy, Ill.
Bean, Hon. Tarleton H., at World's Fair, St. Louis, Mo.
Beeman, Henry W., New Preston, Conn.
Bell, Currie G., Bayfield, Wis.
Belmont, Hon. Perry, 19 Nassau Street, New York.
Bennett, Chas., Woonsocket, R. I.
Bennett, S. R., New Bedford, Mass.
Benton, Judge Henry T., Scale, Ala.

Benton, W. H., Bullochville, Ga.
Bickmore, Prof. A. S., Seventy-seventh Street and Eighth Avenue, New York.
Birge, Prof. E. A., Madison, Wis.
Bissell, John H., Detroit, Mich.
Blackford, Hon. Eugene G., Fulton Market, New York.
Blakeslee, T. J., 353 Fifth Avenue, New York City.
Blatchford, E. W., Chicago, Ill.
Boardman, W. H., Central Falls, R. I.
Booth, A., 36 State Street, Chicago, Ill.
Booth, DeWitt C., Spearfish, South Dakota.
Bottemanne, C. J., Bergen op Zoom, Holland
Boudre, N. H., Plummerville, Ark.
Bowers, Hon. George M., United States Commissioner of Fisheries, Washington, D. C.
Bower, Seymour, Detroit, Mich.
Bower, Ward T., Detroit, Mich.
Bowman, W. H., Rochester, N. Y.
Boyce, F. C., Carson City, Nev.
Bradley, Dr. E., 19 West Thirteenth Street, New York.
Brewer, W. C., Cleveland, O.
Brewster, C. E., Grand Rapids, Mich.
Brewster, W. K., Durand, Mich.
Bross, John L., Mill Creek, Mich.
Brown, George H., Jr., United States Fish Commission, Washington, D. C.
Brown, George M., Saginaw, Mich.
Brush, Dr. E. F., Mount Vernon, N. Y.
Bryant, Gen. E. E., Madison, Wis.
Bulkley, H. S., Odessa, N. Y.
Bullard, C. G., Kalamazoo, Mich.
Bumpus, Dr. H. C., Providence, R. I.
Burham, E. K., Northville, Mich.
Bush, C. P., Columbus, Ga.
Carlo, G. Postiglione di, Naples, Italy.
Carter, E. N., United States Fish Commission, St. Johnsbury, Vt.
Chambers, A. E., Kalamazoo, Mich.
Chase, H. C., 1020 Arch Street, Philadelphia, Pa.

Cheney, A. N., Glens Falls, N. Y.
Clark, Frank N., Northville, Mich.
Clark, Fred, Mill Creek, Mich.
Cobb, E. W., St. Johnsbury, Vt.
Cohen, N. H., Urbana, Ill.
Cole, Leon J., Ann Arbor, Mich.
Collins, Hon. J. C., Providence, R. I.
Cooper, E. A., Cold Spring Harbor, New York.
Corliss, C. S., Gloucester, Mass.
Coulter, A. L., Charlevoix, Mich.
Crook, Abel, 99 Nassau Street, New York.
Crosby, H. F., 30 Broad Street, New York.
Curtis, J. M., Cleveland, O.
Dale, J. A., York, Pa.
Davis, E. A., Bethel, Vt.
Davis, Horace W., Grand Rapids, Mich.
Davis, B. H., Palmyra, N. Y.
Davis, Hon. George B., Utica, Mich.
Dean, Herbert D., United States Fish Commission, Neosho, Mo.
Demuth, H. C., 144 E. King Street, Lancaster, Pa.
DeNyse, Washington I., Gravesend Beach, Borough of Brooklyn, N. Y.
De Rocher, Jas. D., Nashua, N. H.
Dickerson, Freeman B., Detroit, Mich.
Dinsmore, A. H., Green Lake, Me.
Douredoure, B. L., 103 Walnut Street, Philadelphia, Pa.
Downing, S. W., Put-in-Bay, O.
Doyle, E. P., Port Richmond, N. Y.
Dublee, J. Clyde, Williamsport, Penn.
Dunlap, I. H., United States Fish Commission, Washington, D. C.
Ebel, Hon. F. W., Harrisburg, Pa.
Edwards, Vinal N., Woods Hole, Mass.
Ellis, J. Frank, United States Fish Commission, Washington, D. C.
Evarding & Farrell, Messrs., Portland, Ore.
Everman, Prof. Barton W., United States Fish Commission, Washington, D. C.

Fearing, Hon. D. B., Newport, R. I.
Filkins, B. G., Northville, Mich.
Fox, Captain J. C., Put-in-Bay, O.
Frook, John E., Paris, Mich.
Frothingham, H. P., Mount Arlington, N. J.
Fullerton, Samuel F., St. Paul, Minn.
Gavitt, W. S., Lyons, N. Y.
Gebhardt, A. E., Secretary Oregon Fish and Game Association, Salem, Ore.
Geer, Dr. E. F., St. Paul, Minn.
Geer, E. H., Hadlyme, Conn.
George, Hon. A. F., Swanton, Md.
Gilmore, Col. Chas., Swanton, Vt.
Gortz, A. F., Chicago, Ill.
Green, Dr. D. W., Ohio Fish and Game Commission, Dayton, O.
Greene, Myron, Franklin, Vt.
Griffith, S. L., Danby, Vt.
Gunckel, John E., Toledo, O.
Hagert, Edwin, 32 N. Sixth Street, Philadelphia, Pa.
Hahn, Captain E. E., Woods Hole, Mass.
Haley, Caleb, Fulton Market, New York.
Hamilton, Robert, Greenwich, N. Y.
Hampton, F. T., Hill City, Tenn.
Hamsdale, Frank, Madison, Wis.
Handy, L. B., South Wareham, Mass.
Hansen, G., Osceola Mills, Wis.
Harris, J. N., Fulton Market, New York.
Hartley, R. M., 627 Walnut Street, Philadelphia, Pa.
Henkel, C. P., Neosho, Mo.
Henshall, Dr. James A., Bozeman, Montana.
Hill, John L., 115 Broadway, New York.
Hogan, J. J., La Crosse, Wis.
Hogue, William F., Marion, Ala.
Holden, H. S., Syracuse, N. Y.
Hoxie, Chas. A., Carolina, R. I.
Hoxie, J. W., Carolina, R. I.
Howell, John H., 124 Grover Street, Auburn, N. Y.
Hubbard, Waldo F., Nashua, N. H.

Hughes, Frank L., Ashland, N. H.
Hulff, J. H., Norfolk, Neb.
Hunsaker, W. J., Detroit, Mich.
Huntington, L. D., New Rochelle, N. Y.
Hurlbut, H. F., East Freetown, Mass.
Hutchinson, E. S., Washington, D. C.
James, Dr. Bushrod W., n. e. cor. Eighteenth and Green Streets, Philadelphia, Pa.
Jennings, G. E., *Fishing Gazette,* 203 Broadway, New York.
Jensen, Peter, Escanaba, Mich.
Johnson, D. W., Hartwell, Ga.
Johnson, S. M., Union Wharf, Boston, Mass.
Jones, Alexander, Erwin, Tenn.
Jones, Col. James E., Director of Aquarium, Battery Park, New York City.
Jones, Dr. O. L., 116 West Seventy-second Street, New York.
Joseph, D., Columbus, Ga.
Joslin, Hon. C. D., Detroit, Mich.
Kashiwa, A. M., Seattle, Wash.
Kauffmann, S. H., *Evening Star,* Washington, D. C.
Keller, H. N., California Fish Commission, Santa Monica, Cal.
Kelly, P., 346 Sixth Avenue, New York.
Kennedy, Edwin M., Ohio Fish and Game Commission, McConnellsville, O.
Kendall, Dr. William C., United States Fish Commission, Washington, D. C.
Kenyon, A. W., Usquepaugh, R. I.
Kerr, Captain J. R., Pittsurgh, Pa.
Kiel, W. M., Tuxedo Park, N. Y.
Lamkin, J. Bayard, Bullochville, Ga.
Landers, E. T., Hopeville, Ga.
Lane, George F., Silver Lake, Mass.
Lawton, Col. J. P., Columbus, Ga.
Leach, G. C., 1516 Locust Street, St. Louis, Mo.
Leary, John L., United States Fish Commission, San Marcos, Tex.
LeGettee, K., Centenary, S. C.

Lewis, Charles E., Chamber of Commerce, Minneapolis, Minn.
Locke, E. F., Woods Hole, Mass.
Lovejoy, Samuel, Bullochville, Ga.
Lydell, Dwight, Mill Creek, Mich.
McGowan, Hon. H. P., 108 Fulton Street, New York.
Mallory, Chas., Burling Slip, New York.
Mancha, H. H., Northville, Mich.
Manning, W. W., Marquette, Mich.
Mansfield, H. B., Lieutenant Commander United States Navy, 368 Hancock Street, Brooklyn, N. Y.
Manton, Dr. W. P., Detroit, Mich.
Marks, H. H., Sault Ste. Marie, Mich.
Marks, J. P., Paris, Mich.
Marsh, M. C., Washington, D. C.
Mathewson, G. T., Thompsonville, Conn.
May, W. L., Omaha, Neb.
Mead, Prof. A. D., Brown University, Providence, R. I.
Meehan, W. E., *Public Ledger*, Philadelphia, Pa.
Merritt, F. H. J., Altamont, N. Y.
Merrill, M. E., St. Johnsbury, Vt.
Mershon, W. B., Saginaw, Mich.
Miller, Frank, Put-in-Bay, O.
Miller, Geo. F., Put-in-Bay, O.
Miller, W. S., Gallion, O.
Milliken, Dr. J. D., United States Fish Commission, Woods Hole, Mass.
Mills, G. F., Carson City, Nev.
Mitchell, Prof. Irving M., Milwaukee, Wis.
Mitchell, John A., Columbus, Ga.
Monroe, Otis, Mill Creek, Mich.
Moody, G. C., Mill Creek, Mich.
Moore, Chas. H., Detroit, Mich.
Morgan, H. A., Baton Rouge, La.
Morrell, Daniel, Hartford, Conn.
Morse, Grant M., Portland, Mich.
Morton, W. P., Providence, R. I.
Mosher, Stafford, Fort Plain, N. Y.

Mullett, R. M., United States Fish Commission, Washington, D. C.

Mussey, George D., Detroit, Mich.

Nash, Dr. S. M., 63 West Forty-ninth Street, New York.

Neal, John R., 22 1-2 "T" Wharf, Boston, Mass.

Nevin, James, Madison, Wis.

North, Paul, Ohio Fish and Game Commission, Cleveland, Ohio.

Oberfelder, R. S., Sidney, Neb.

O'Brien, W. J., South Bend, Neb.

O'Connor, E. M., Savannah, Ga.

O'Hage, Dr. Justus, St. Paul, Minn.

O'Malley, Henry, Baker, Washington.

Orr, W. J., Bay Port, Mich.

Osborn, Wm., Duluth, Minn.

Page, P. W., West Summit, N. J.

Palmer, W. A., Buchanan, Mich.

Parker, Dr. J. C., Grand Rapids, Mich.

Parker, W. H., Lac la Peche, Quebec, Canada.

Paxton, Thomas B., Ohio Fish and Game Commission, Cincinnati, O.

Peabody, George F., Appleton, Wis.

Pearce, Caption T. C., United States Fish Commission, Washington, D. C.

Peck, Hon. Stephen, Warren, R. I.

Pike, Robert G., Middletown, Conn.

Plumb, Charles, Mill Creek, Mich.

Powell, W. L., Harrisburg, Pa.

Powers, J. A., Lansingburg, N. Y.

Powers, John W., Big Rapids, Mich.

Prather, J. Hub, Lexington, Ky.

Prendergast, Charles F., 1420 Lincoln Street, Savannah, Ga.

Preston, Hon. John L., Port Huron, Mich.

Preston, Dr. Henry G., 98 Lafayette Square, Brooklyn, N. Y.

Proctor, Hon. Redfield, Proctor, Vt.

Rathbone, Wm. F., D. & H. R. R., Albany, N. Y.

Rathbun, Richard, Smithsonian Institution, Washington, D. C.

Ravenel, W. DeC., United States Fish Commission, Washington, D. C.
Reighard, Prof. Jacob E., University of Michigan, Ann Arbor, Mich.
Richards, G. H., Boston, Mass.
Roberts, A. D., Woonsocket, R. I.
Robinson, W. E., Mackinaw City, Mich.
Robinson, A. H., St. Johnsbury, Vt.
Rodgers, Frank A., Grand Rapids, Mich.
Rodgers, J. L., Ohio Fish and Game Commission, Columbus, Ohio.
Rogers, J. M., Chicago, Ill.
Root, Henry T., Providence, R. I.
Rosenberg, Albert, Kalamazoo, Mich.
Ruge, John G., Apalachicola, Fla.
Russell, Henry, Detroit, Mich.
Sampson, E. R., care of New York Aquarium, Battery Park, New York City.
Sanborn, F. G., 612-622 California Street, San Francisco, Cal.
Saunders, Dr. H. G., Chattanooga, Tenn.
Scarborough, L. A., Columbus, Ga.
Schley, Dr. F. V., Columbus, Ga.
Schute, John A., Havana, Ill.
Schweikart, Walter, Detroit, Mich.
Seagle, Geo. A., Wytheville, Va.
Self, E. M., Bullochville, Ga.
Sellers, M. G., Philadelphia, Pa.
Sexton, Cramer, Murfreesboro, Tenn.
Sherwin, H. A., 100 Canal Street, Cleveland, O.
Simons, Max, Columbus, Ga.
Singleton, James H., Woonsocket, R. I.
Smith, Henry D., Appleton, Wis.
Smith, Jay, care of J. W. Marston & Co., Lewis Wharf, Boston, Mass.
Smith, L. H., Algona, Iowa.
Smith, Dr. Hugh M., United States Fish Commission, Washington, D. C.
Smith, Capt. J. A., Woods Hole, Mass.

Snyder, Dr. F. B., Ashtabula, Ohio.
Solman, Alden, South Norwalk, Conn.
Southwick, J. M. K., Newport, R. I.
Spencer, L. B., Supt. Aquarium, 37 W. 128th Street, New York City.
Spensley, Calvert, Mineral Point, Wis.
Springer, F. H., Columbus, Ga.
Starbuck, Alexander, Cincinnati, O.
Starr, W. J., Eau Claire, Wis.
Stelle, G. F., Chicago, Ill.
Sterling, J. E., Crisfield, Md.
Stewart, Chas. E., Westerly, R. I.
Stewart, A. T., Northville, Mich.
Stone, Livingston, Cape Vincent, N. Y.
Stranahan, J. J., Bullochville, Ga.
Stranahan, F. A., Cleveland, O.
Stranahan, F. F., Cleveland, O.
Stranahan, H. B., Cleveland, O.
Suthers, Frank, Madison, Wis.
Sykes, Arthur, Madison, Wis.
Sykes, Henry, Bayfield, Wis.
Tawes, J. C., Crisfield, Md.
Taylor, A. R., 318 Main Street, Memphis, Tenn.
Thayer, W. W., 234 Joseph Campau Avenue, Detroit, Mich.
Thomas, Henry G., Stowe, Vt.
Thompson, Carl G., 78 Henry Street, Huntington, Ind.
Thompson, W. T., Nashua, N. H.
Thompson, W. P., 112 Bread Street, Philadelphia, Pa.
Tinker, E. F., St. Johnsbury, Vt.
Titcomb, John W., United States Commission of Fish and Fisheries, Washington, D. C.
Townsend, Chas. H., United States Fish Commission, Washington, D. C.
Trumpour, D. A., Bay City, Mich.
Tubbs, Frank A., Neosho, Mo.
Tucker, Edmund St. George, Bedford Row, Halifax, N. S.
Tulian, Eugene A., Leadville, Colo.
Turner, J. C., Columbus, Ga.

VanDusen, Hon. H. G., Master Fish Warden of Oregon, Astoria, Ore.

Vincent, W. S., United States Commission of Fish and Fisheries, Washington, D. C.

Vogelsang, Alexander T., Mills Building, San Francisco, Cal.

Walker, Bryant, Detroit, Mich.

Wallett, W. H., Put-in-Bay, O.

Walters, C. H., Cold Spring Harbor,, N. Y.

Ward, Prof. H. B., Lincoln, Neb.

Webb, W. Seward, Forty-fourth Street and Vanderbilt Avenue, New York.

Wentworth, Edwin, United States Fish Commission, Nashua, N. H.

Wentworth, Nathaniel, Hudson Centre, N. H.

Weed, W. R., Potsdam, N. Y.

Wetherbee, W. C., Port Henry, N. Y.

Wheeler, Chas. Stetson, Hobart Building, San Francisco, Cal.

Whish, John D., Secretary, Forest, Fish and Game Commission, Albany, N. Y.

White, R. Tyson, 320 Bridge Street, Brooklyn, N. Y.

Wilbur, H. O., 235 Third Street, Philadelphia, Pa.

Wilbur, P. H., Little Compton, R. I.

Willard, Chas. W., Westerly, R. I.

Willetts, J. C., 40 Wall Street, New York.

Williams, J. A., St. Johnsbury, Vt.

Wilson, C. H., Glens Falls, N. Y.

Wilson, S. H., Cleveland, O.

Winn, Dennis, Nashua, N. H.

Wires, S. P., Lester Park, Duluth, Minn.

Wisner, J. Nelson, Jr., United States Fish Commission, Washington, D. C.

Wood, C. C., Plymouth, Mass.

Woodruff, C. B., Columbus, Ga.

Wride, Geo. A., Grindstone City, Mich.

Zalsman, Philip G., Paris, Mich.

Zweighapt, S., Deer Park, Haines Falls, N. Y.

HONORARY.

Borodine, Nicholas, Delegate of the Russian Association of Pisciculture and Fisheries, Uralsk, Russia.

Fish Protective Association of Eastern Pennsylvania, 1020 Arch Street, Philadelphia, Pa.

Lake St. Clair Shooting and Fishing Club, Detroit, Mich.

New York Association for the Protection of Fish and Game, New York City.

Peck, Hon. Geo. W., Milwaukee, Wis.

South Side Sportsmen's Club, Oakdale, L. I., N. Y.

Sweeny, Dr. R. O., Lester Park, Duluth, Minn.

The President of the United States.

The Governors of the Several States.

Woodmont Rod and Gun Club, Washington, D. C.

CORRESPONDING.

Apostolides, Prof. Nicoly Chr., Athens, Greece.

Armistead, J. J., Dumfries, Scotland.

Birbeck, Edward, Esq., M. P., London, England.

Brady, Thos. F., Esq., Inspector of Fisheries, Dublin Castle, Dublin, Ireland.

Calderwood, W. L., Esq., Inspector of Salmon Fisheries, Edinburgh, Scotland.

Feddersen, Arthur, Copenhagen, Denmark.

Feilding, J. B., Upper Downing, Holywell, North Wales.

Giglioli, Prof. Enrico H., Florence, Italy.

Ito, K., Member of Fisheries Department of Hokkaido and President of the Fisheries Society of Northern Japan, Sapporo, Japan.

Jaffe, S., Osnabruck, Germany.

Juel, Capt. N., R. N., President of the Society for the Development of Norwegian Fisheries, Bergen, Norway.

Landmark, A., Inspector of Norwegian Fresh Water Fisheries, Bergen, Norway.

Lundberg, Dr. Rudolph, Inspector of Fisheries, Stockholm, Sweden.

Maccleay, William, President of the Fisheries Commission of New South Wales, Sydney, N. S. W.

Marston, R. B., Esq., Editor of the *Fishing Gazette*, London, England.

Olsen, O. T., Grimsby, England.

Sars, Prof. G. O., Government Inspector of Fisheries, Christiania, Norway.

Senior, William, London, England.

Smitt, Prof. F. A., Stockholm, Sweden.

Sola, Don Francisco Garcia, Secretary of the Spanish Fisheries Society, Madrid, Spain.

Solsky, Baron N. de, Director of the Imperial Agricultural Museum, St. Petersburg, Russia.

Trybom, Dr. Filip, Stockholm, Sweden.

Walpole, Hon. Spencer, Governor of the Isle of Man.

Wattel, M. Raveret, Secretary of the Societe d'Acclimation, Paris, France.

RECAPITULATION.

Active	332
Honorary	54
Corresponding	24
Total membership	410

CONSTITUTION.

(As amended to date).

ARTICLE I.

NAME AND OBJECTS.

The name of this Society shall be American Fisheries Society. Its objects shall be to promote the cause of fish culture; to gather and diffuse information bearing upon its practical success, and upon all matters relating to the fisheries; the uniting and encouraging of all the interests of fish culture and the fisheries, and the treatment of all questions regarding fish, of a scientific and economic character.

ARTICLE II.

MEMBERS.

Any person shall, upon a two-thirds vote and the payment of one dollar, become a member of this Society. In case members do not pay their fees, which shall be one dollar per year, after the first year and are delinquent for two years, they shall be notified by the Treasurer, and if the amount due is not paid within a month thereafter, they shall be, without further notice, dropped from the roll of membership. Any person can be made an honorary or a corresponding member upon a two-thirds vote of the members present at any regular meeting.

Any person shall, upon a two-thirds vote, and the payment of $15.00, become a life member of this Society, and shall thereafter be exempt from all annual dues.

ARTICLE III.

OFFICERS.

The officers of this Society shall be a President and a Vice President, who shall be ineligible for election to the same office

until a year after the expiration of their term; a Corresponding Secretary, a Recording Secretary, a Treasurer and an Executive Committee of seven, which with the officers before named, shall form a council and transact such business as may be necessary when the Society is not in session, four to constitute a quorum.

ARTICLE IV.

MEETINGS.

The regular meeting of the Society shall be held once a year, the time and place being decided upon at the previous meeting or, in default of such action, by the Executive Committee.

ARTICLE V.

ORDER OF BUSINESS.

1. Call to order by President.
2. Roll call of members.
3. Applications for membership.
4. Reports of officers.
   a. President.
   b. Secretary.
   c. Treasurer.
   d. Standing Committees.
5. Committees appointed by the President.
   a. Committee of five on nomination of officers for ensuing year.
   b. Committee of three on time and place of next meeting.
   c. Auditing committee of three.
6. Reading of papers and discussions of same.

(Note—a. In the reading of papers preference shall be given to members present.
b. The President and two Secretaries are empowered to arrange the papers of the meetings of the Society).

7. Miscellaneous business.
8. Adjournment.

ARTICLE VI.

CHANGING THE CONSTITUTION.

The Constitution of the Society may be amended, altered or repealed by a two-thirds vote of the members present at any regular meeting, provided at least fifteen members are present at said meeting.